AMERICAN ENGINEER AND RAILROAD JOURNAL.

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CONTENTS.

AMERICAN ENGINEER TESTS.

LOCOMOTIVE DRAFT APPLIANCES.

XII.

Report by Professor W. F. M. Goss.

SECTION V.

(*Continued from Page* 331.)

33. Stacks and Exhaust Pipes.—Photographs giving a general impression of the form and character of the stacks and exhaust pipes chiefly experimented upon, have already been presented as Figs. 2, 3 and 4. A more complete definition of the sectional stacks especially designed for the experiments is shown by Fig. 26. The experimental stacks were of four different diameters, each diameter having a base of more or less taper. This base constituted the shortest length of stack employed. Increased length was obtained by the addition of 10-in. sections.

The notations in Fig. 26 are the same as are employed in connection with the presentation and all discussion of data. A No. 7 stack is a straight stack 15¾ ins. in diameter. A No. 7-A stack is a stack 26½ ins. long, while a No. 7-D stack is a stack 56½ ins. long. Similarly, a No. 8-A is a taper stack 15½ ins. in diameter at the choke and 26½ ins. long. A comprehensive definition of the stack terms used in connection with the data is presented as Table V.

TABLE V.
Stack Dimensions.

1 Designation.	2 Form.	3 Smallest Diameter, Inches.	4 Total Height, Inches.	5 Distance from Center Line of Boiler to Top of Stack.
Base No. 1............		9¾	16½	45 1-16
1-A..............	Straight	9¾	26½	55 1-16
1-B..............	Straight	9¾	36½	65 1-16
1-C..............	Straight	9¾	46½	75 1-16
1-D..............	Straight	9¾	56½	85 1-16
2-A..............	Taper	9¾	26½	55 1-16
2-B..............	Taper	9¾	36½	65 1-16
2-C..............	Taper	9¾	46½	75 1-16
2-D..............	Taper	9¾	56½	85 1-16
Base No. 2............		11¾	16½	45 1-16
3-A..............	Straight	11¾	26½	55 1-16
3-B..............	Straight	11¾	36½	65 1-16
3-C..............	Straight	11¾	46½	75 1-16
3-D..............	Straight	11¾	56½	85 1-16
4-A..............	Taper	11¾	26½	55 1-16
4-B..............	Taper	11¾	36½	65 1-16
4-C..............	Taper	11¾	46½	75 1-16
4-D..............	Taper	11¾	56½	85 1-16
Base No. 3............		13¾	16½	45 1-16
5-A..............	Straight	13¾	26½	55 1-16
5-B..............	Straight	13¾	36½	65 1-16
5-C..............	Straight	13¾	46½	75 1-16
5-D..............	Straight	13¾	56½	85 1-16
6-A..............	Taper	13¾	26½	55 1-16
6-B..............	Taper	13¾	36½	65 1-16
6-C..............	Taper	13¾	46½	75 1-16
6-D..............	Taper	13¾	56½	85 1-16
Base No. 4............		15¾	16½	45 1-16
7-A..............	Straight	15¾	26½	55 1-16
7-B..............	Straight	15¾	36½	65 1-16
7-C..............	Straight	15¾	46½	75 1-16
7-D..............	Straight	15¾	56½	85 1-16
8-A..............	Taper	15¾	26½	55 1-16
8-B..............	Taper	15¾	36½	65 1-16
8-C..............	Taper	15¾	46½	75 1-16
8-D..............	Taper	15¾	56½	85 1-16
Normal	Taper	14	48	75 9-16
Sliding..............	Straight	13¾	26½ to 56½	56 1-16 to 85 1-16

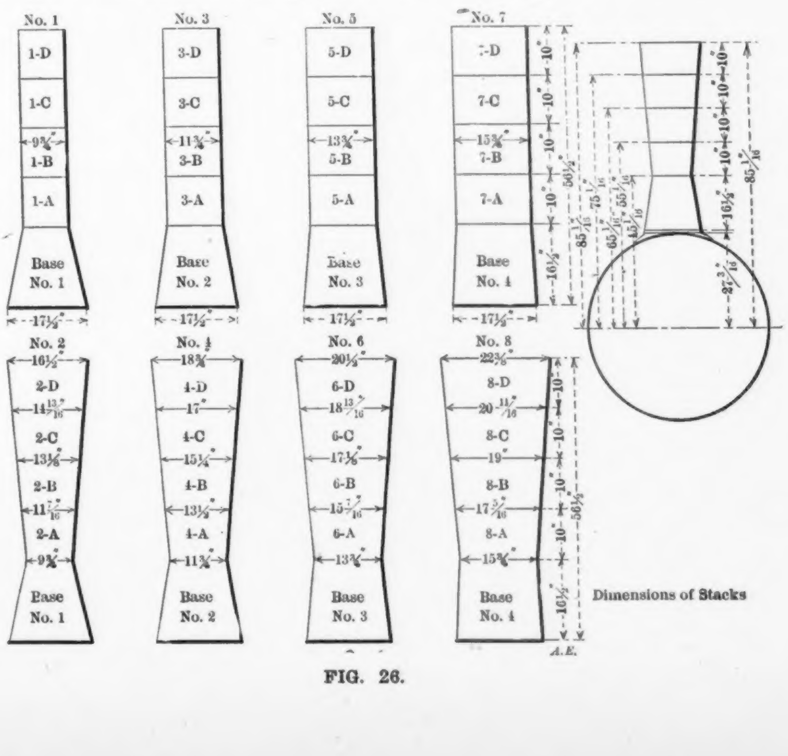


FIG. 26.

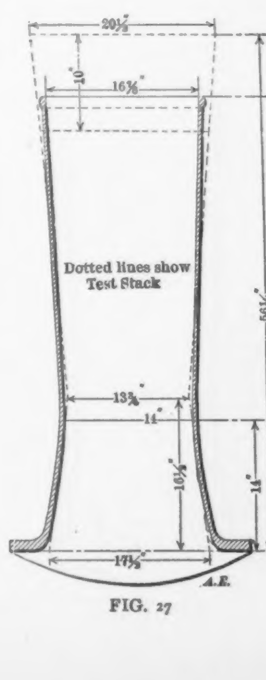


FIG. 27

The normal stack, which was supplied by the builders of locomotive Schenectady No. 2, with the engine, was subjected to the same tests as the sectional stacks. Its dimensions, compared with those of the 6-D and 6-E stack, with which its form most nearly agrees, is shown by Fig. 27.

The experimental exhaust pipes and nozzles, with the reference numbers which are always employed therewith are shown

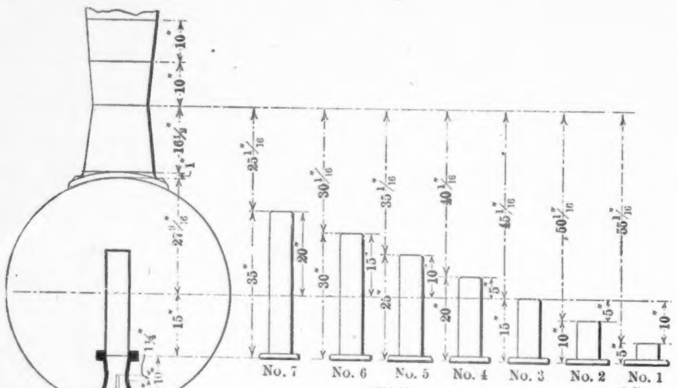


FIG. 28

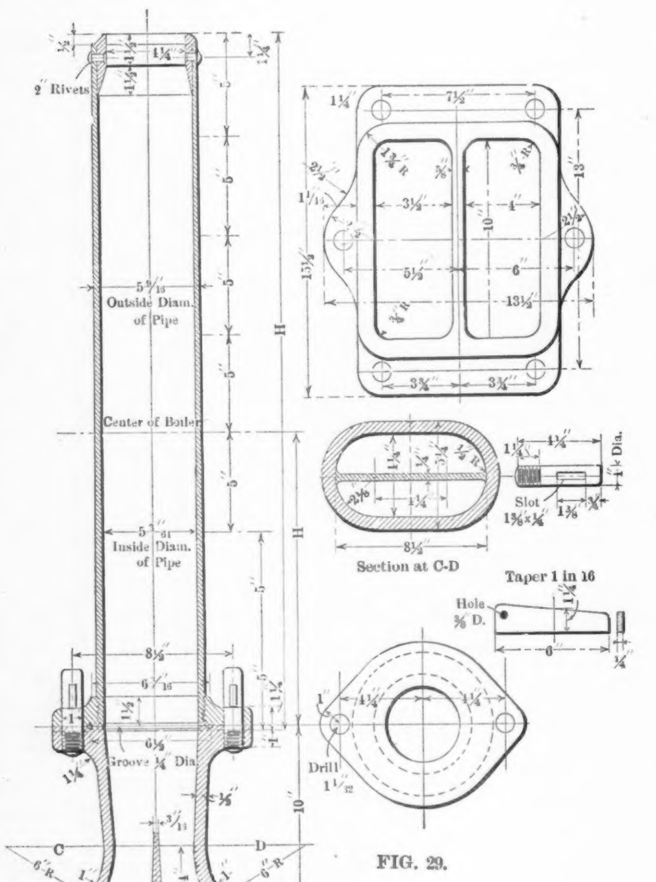


FIG. 29.

by Fig. 28. Thus, No. 1 pipe or nozzle is 5 ins. high upon a 10-in. base, while nozzle No. 7 is 35 ins. high upon a 10-in. base. While these will hereafter be referred to as nozzles, they really combine in one design a pipe and nozzle, as will be seen by the drawing representing their construction, Fig. 29. All nozzles were used upon the same base which, as shown, was 10 ins. in height.

34. Results.—While an array of figures presents few attractions for the average reader, the significance of the present work is such that it seems wise to include in this report, for future reference, as well as for the benefit of the present-day student of stack design, a complete record of the data obtained. Following this will be found such summarized statements of the facts disclosed as will serve those who have little time in which to follow an elaborate array of details.

The results, representing more than a thousand distinct tests for each of which the locomotive was at least once started, brought with great precision to a specified condition of running, and stopped again, are for convenience arranged in eight tables, numbered from VI. to XIII. inclusively, which follow.

(*To be continued.*)

PIECEWORK IN A LOCOMOTIVE ERECTING SHOP.

Suggestions Based Upon Successful Experience.

By J. Komo.

Strange as it may seem at this late day, many mechanical railroad men argue that piecework cannot be successfully introduced into a locomotive erecting shop on account of the many complications arising daily. They are honest in their opinions and these should be given due consideration, but when they once seriously undertake to solve the problem they will ask themselves the question, Why they did not do this before? Here are a few quotations by a well-known author which it may be well for us to study when preparing to put an erecting shop or any other department on a piecework basis:

"Before we change our action we have to change our ideas of the things toward which we act; our idea of the thing directs our action toward it. If our idea of the thing is right, our action toward it will be right; if our idea of the thing is wrong, our action toward it will be wrong. It is a rule to which there is no exception. There is only one way by which we can acquire knowledge of anything, and that is to first get an imperfect idea of it, then a more perfect one, and so on until our idea of it is complete."

Before starting piecework in the locomotive erecting shop the shop should be carefully systematized, and, where possible, work assigned to certain men. This is now done in many day-work shops, and has proved to be a good way of handling the erecting shop work. Shoes and wedges should be considered as one job; guides, steam chests, pistons, boring out cylinders and all that pertains to this class of work should be another; fitting cylinders, chipping cylinder saddles, and everything that pertains to this class of work should be another; cab work and framing should be another, and replacing drivers and trucks and everything that pertains to it should be another, and so on. Certain men should be assigned to general work—meaning jobs that cannot be consistently grouped. As far as practicable, stripping should be done by the men who are to replace the work, as they will then know the conditions the work is in when it came down, and will be better able to order parts for renewal, and will take more interest in doing the work if they know they are to replace it. Many other subdivisions of the work may be made when in the foreman's judgment it is wise. It is understood that men to have special jobs will look after them all the time on every engine that goes through the shop and not wait to be told by the gang boss or foreman. The foreman, of course, will have the same control of the shop that he always had, and will indicate the engines he wants first and call attention to anything that pertains to the work, but as long as affairs run along to his liking and smoothly, probably he will not say anything to the men from one end of the week to the other. Special men soon learn to watch the work with as much interest as the foreman, because the faster the work moves along the more money they make.

There should be a piecework inspector in a shop where there

are 40 or more men employed. If there are a smaller number than this, one piecework inspector will handle the entire machine shop, machines and erecting, too. The piecework inspector in the erecting shop should be a practical, first-class machinist and thoroughly competent to pass on work, and a man who is absolutely reliable and absolutely fair. He should, as far as practicable, see every job that he pays for, and if it is not satisfactory he should try to readjust it with the men who did the work, and when he cannot do this he should call the foreman's attention to it, as he is in no way to interfere with the duties of the foreman.

If the shop is systematized as outlined, a careful record should be made of the time it takes to perform the different operations, and when enough information has been secured to warrant it, this should be carefully analyzed by the foreman, gang boss and piecework inspector. Each operation must be studied very carefully from a commercial standpoint; those in charge of piecework should figure what they would pay for the work if they owned the road, remembering that there are clearly two sides to the question, and that the men have rights as well as the company. In case of doubt on any job it would be well to do the work over again and take the record a second time.

It will not do to base piecework prices on the record of an exceptionally fast man or on work done under forced effort, as when this man works on piecework he is expected to largely increase his earnings. Neither will it do to base the piecework price on the slowest man, as that would be unfair to the company. Experience will soon determine just where to draw the line in these cases. If the men can be made to feel that their interests and those of the company are the same and if they can be consulted to make these prices, a great deal of trouble is avoided.

Care should be used to specify just what is intended to be done for a given price, leaving no room for doubt. This will at first be very difficult, but in time one will be enabled to cover this point very clearly. The officers should insist on first-class work and make the prices high enough, so that the men can do it as it ought to be done, because poor work is expensive at any price.

If an erecting shop is properly handled on a piecework basis it is one of the most satisfactory departments in a large railroad shop, both for the company and the men. It means increased output and decreased cost for the company, and better wages for the men and more agreeable positions. Many little squalls will come up in starting the department—some things will be unfair to the company and some to the men—but time and patience and the desire to do the right thing on both sides, and a clear understanding that this is the desire, will soon straighten matters out.

A few sample pages of a locomotive erecting shop schedule which has been in successful use for several years will form the subject of another article on this subject.

LIQUID FUEL.

Burners Which Do Not Atomize.

[Editor's Note.—The writer of this article has had wide experience in the use of oil as fuel for heating and welding burners and has been very successful.]

Fuel oil has long been recognized as a fuel that possesses many advantages over coal. It contains more heat-producing power than an equal weight of any other material that exists in large quantities, and containing no ashes, every portion may be burned to produce heat.

There is no doubt that the unsatisfactory results obtained by many who have used a liquid fuel has retarded its use, mainly owing to the fact that it has been proved to them that they were not getting the heat-producing efficiency from the fuel that it is supposed to be capable of giving.

Several hundred patents have been issued in this field in the past few years, and invariably the patentee has aimed to produce a burner that would atomize the fuel—in other words, one that would break the oil up into minute particles, so that when brought into combustion with the necessary oxygen it would be evenly distributed and minute enough to form the necessary chemical combination for perfect combustion.

Failures of this class of burners have been frequent, due in many cases to the fact that the combustion does not take place until the vapor or mixture is a considerable distance from the burner. In other cases, failure has resulted from relying upon the temperature of the furnace to obtain perfect combustion.

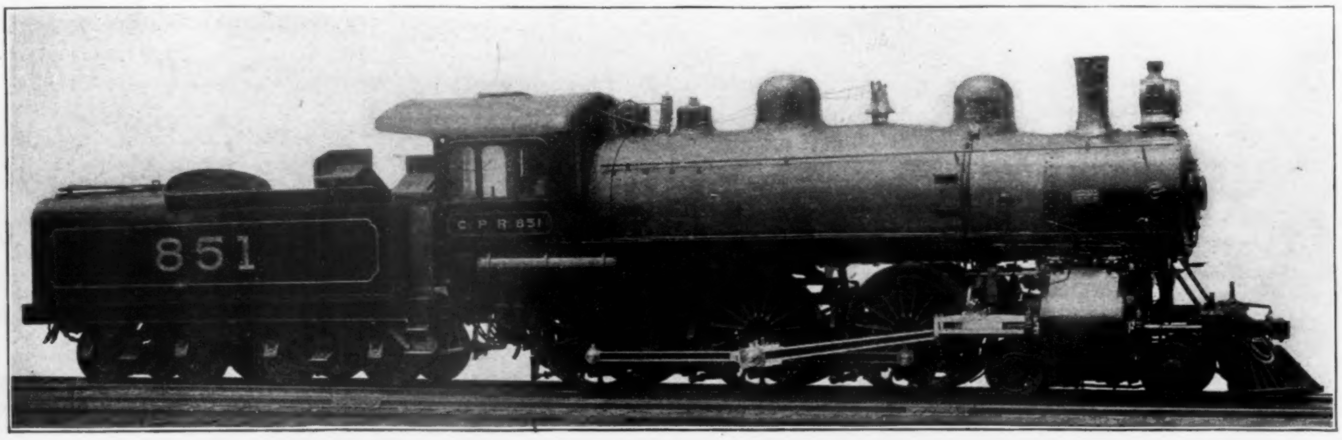
Fuel oil contains from 19,000 to 22,000 B. T. U. per lb., and from the best practice we find it necessary to supply this fuel with from 20 to 24 lbs. of air. It must be supplied in such proportion as will result in a bringing together of the right proportion of the gases at the right time to obtain the desired result—perfect combustion. If this is accomplished, we have a fuel that whereas its theoretical efficiency over coal is only 45 per cent., yet has a calorific energy more than 60 per cent. greater than bituminous coal. In the cases where it has been attempted to burn a liquid fuel by atomizing and burning it in the chamber in which the work has to be done, either heating material or raising steam, the results have shown a woeful difference between the efficiency obtained and the supposed efficiency of the fuel. This is due, no doubt, to the hydrocarbons passing off without giving up the heat units contained therein.

Many attempts have been made to obtain the full efficiency by having the oil undergo a preliminary treatment to convert it into a gas or vapor before trying to burn it. The failures of these gas generators have been common, and have done much to retard the use of oil in shops. Among the many types of oil burning devices placed on the market during the past few years, there is one system of oil furnaces that has many new features, inasmuch as the oil is not atomized, but is simply brought into combustion with a quantity of oxygen or fan blast. Partial combustion takes place, and the hydrocarbons burn on their way up a vertical combustion chamber; on reaching the top they come into combination with a further supply of air. The fuel is now in a state of perfect combustion; the oil and air supply, which are independent and under the control of the operator, can be regulated to a nicety. The manufacturers of these furnaces claim to obtain perfect combustion, as they have a number of welding heat furnaces in use for such work as welding tubes, small forging, etc., etc., in which the material has to be handled very rapidly, and in a perfect heat. Presumably they must have an improved system of combustion.

Liquid fuel, like other innovations, is a subject that requires thought, time and experience to perfect its use, and it is not only necessary to provide for a perfect combustion, but the furnace must be designed on correct principles, so that the greatest use may be made of the heat, and the number of important economies over coal or coke will not be fully realized until such properly designed oil furnaces are in use. It will then be found that by far the greatest economy will not be through a reduction in the cost of fuel, which should be from 25 to 50 per cent., depending upon the cost of oil, but in the increased output made possible by the use of this fuel. Its capacity for doing work should range all the way from 50 to 300 per cent. more than coal or coke, which means a big reduction in shop cost.

This increase in output is made possible by the perfect and easy regulation obtained with oil. The time of the men is wholly given to their work, and not to tending their fires. The uniform heat and absence of oxidation of the metal in-

sures that each piece is heated in a perfect manner, and no material is lost through faulty heat treatment. No fuel is required when the furnace is not doing useful work. There is a further advantage in that no labor is required for bringing fuel to and removing ashes from the furnace, which is necessary in the use of coal or coke. Oil also contains little or no sulphur or phosphorus to attack the metal heated, and with the perfect combustion that should be made possible by the use of oil fuel, the metal is not injured in any way by being heated. Especially for such work as welding, the perfect combustion and absolutely clean fire made possible by the use of a liquid fuel, should certainly bring this fuel to the front for shop purposes. It should be remembered that the output of a blacksmith shop is not the capacity of the forging machines, but rather the capacity of the furnaces to supply the material in such a condition that it may be handled rapidly.



Two-Cylinder Compound Ten-Wheel Locomotive.—Canadian Pacific Railway.

E. A. WILLIAMS, *Supt. of Rolling Stock.* AMERICAN LOCOMOTIVE CO., SCHENECTADY WORKS, *Builders.*

TWO-CYLINDER COMPOUND LOCOMOTIVES.

Canadian Pacific Railway.

4-6-0 Type.

Double-Ported Piston Valve on Low-Pressure Cylinder.

This is the most recent development of the two-cylinder compound for passenger service. It employs piston valves with outside admission and the usual form of valve motion, and has a double-ported valve for the low-pressure cylinder. This valve was developed at the Schenectady works of the American Locomotive Company several years ago, and was recently applied also to a two-cylinder compound on the Chicago & Eastern Illinois. Its purpose is to provide double admission and double exhaust ports to the low-pressure cylinder, to secure easy entrance and exit for the steam, and also to secure a perfectly balanced valve for this cylinder. The construction of the valves and the cylinders is made clear by the engravings. This valve should enable the engine to run at high speed, and if there is any foundation for the claim that this type is handicapped in speed, this design ought to overcome it. Thus far there has been no attempt on the Canadian Pacific to determine this point. To reduce the braking effect of the low-pressure piston in drifting, the low-pressure cylinder is fitted with two large, automatic, by-pass valves, which appear in the photograph. The American Locomotive Company and the mechanical officials of the Canadian Pacific are apparently of the opinion that the two-cylinder compound has not yet reached the limit of its development.

Two-cylinder compounds are not, as a rule, handsome, but this is an exception. The Canadian Pacific tender and cab, with curved outlines, together with the piston valves, make a really attractive combination. The following table of dimensions will be convenient for reference:

Two Cylinder Compound Passenger Locomotive.

4—6—0 Type.

Canadian Pacific Railway.

General Demensions.

Gauge	4 ft., 8½ in.
Fuel	Bituminous coal
Weight in working order	168,000 lbs.
Weight on drivers	124,000 lbs.
Wheel base, driving	14 ft., 10 in.
Wheel base, rigid	14 ft., 10 in.
Wheel base, total	25 ft., 11 in.

Cylinders.

Diam. of cylinders	22 in. and 35 in.
Stroke of piston	26 in.
Horizontal thickness of piston	H. P., 5¾; L. P., 4⅛ in.
Diam. of piston rod	3¾ in.
Kind of piston packing	Cast-iron rings
Kind of rod packing	Metallic

Valves.

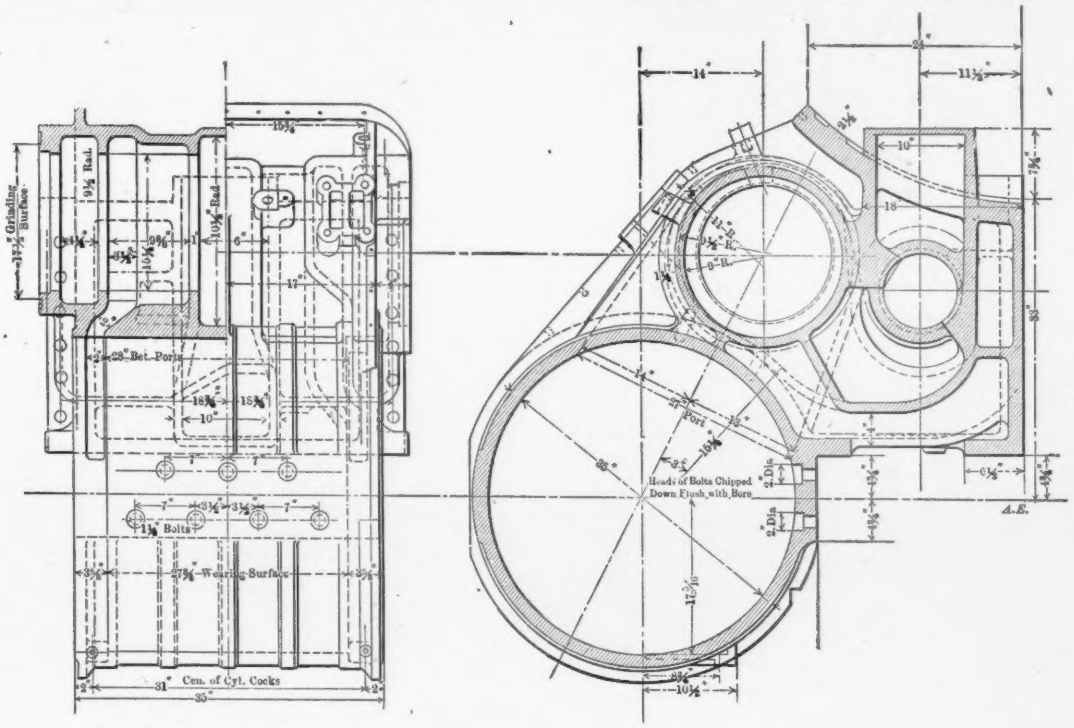
Kind of slide valves	Piston type
Greatest travel of slide valves	6 in.
Outside lap of slide valves	H. P. 1¼; L. P., 1 in.
Inside lap clearance	H. P., ¼; L. P., ⅜ in.
Lead of valves in full gear	Line and line
Kind of valve stem packing	Metallic

Wheels, etc.

Diam. driving wheels outside of tire	69 in.
Material of driving wheels, centers	cast steel
Tire held by	Shrinkage
Driving box material	Cast steel
Diam. and length of driving journals	9 in. diam. × 12 in.
Diam. and length of main crank pin journals	7 in. diam. × 6½ in.
Diam. and length of slide rod crank pin journals, main side	7½ in. × 4 ¾ in.; F. & B. 5 in. dia. × 4½ in.
Engine truck, kind	4-wheel swing bolster
Engine truck journals	6 in. dia. × 10 in.
Diam. of engine truck wheels	30 in.
Kind of engine truck wheels	Steel tired; cast-iron spoke center

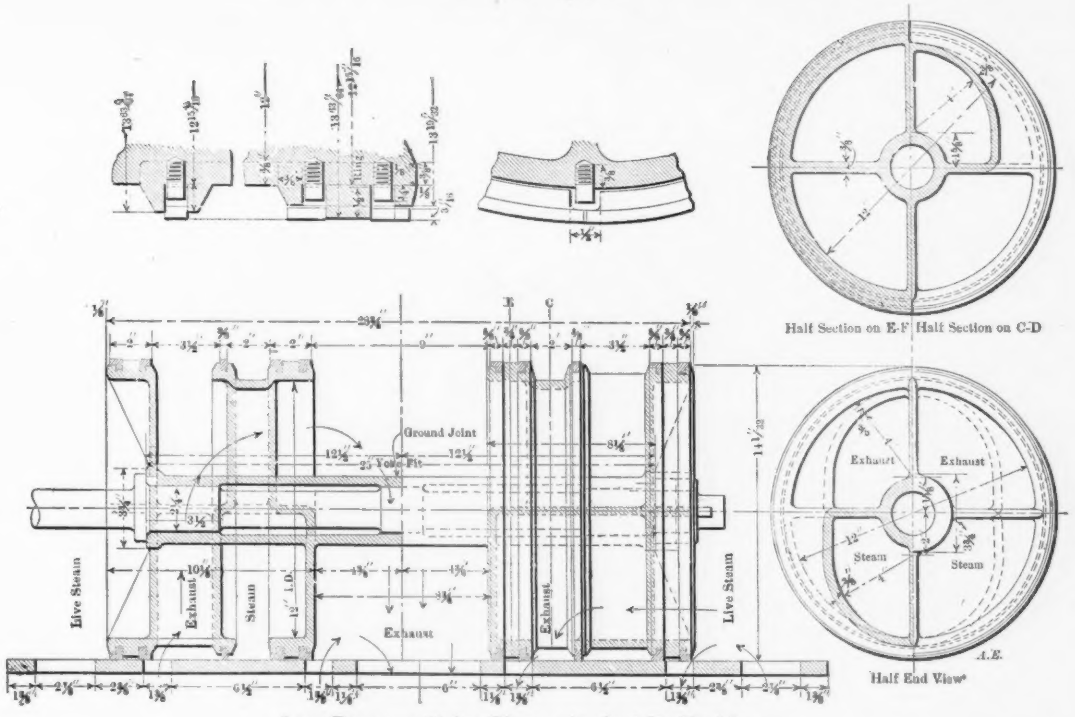
Boiler.

Style	Wagon top
Outside diam. of first ring	62½ in.
Working pressure	210 lbs.
Material of barrel and outside of fire box	Steel
Thickness of plates in barrel and outside of fire box	½ and ¾ in.
Fire box, length	108 in.
Fire box, width	41 in.
Fire box, depth	F. 76½ ins., B. 64½ ins.
Fire box, material	Steel
Fire box, plates, thickness	sides, ⅜ in.; back, ⅜ in; crown, ⅜ in.; tube sheet, ½ in.
Fire box, water space	front, 4½ and 5 ins.; sides, 3½ and 4 ins.; back, 3½ and 4½ ins.
Fire box, crown staying, radial	18 ins. diameter
Fire box, stay bolts, iron	1 in. diameter
Tubes, number of	312



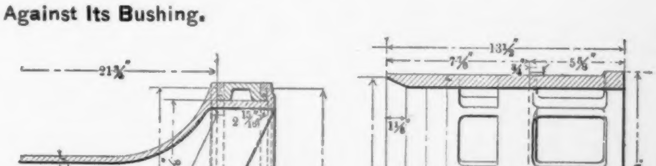
Part Section of Valve Chest. Cross Section.

Low Pressure Cylinder.



Low Pressure Valve Shown Against Its Bushing.

Tubes, diameter	2 ins.
Tubes, length over tube sheets	14 ft. 0 in.
Heating surface, tubes	2273.3 sq. ft.
Heating surface, fire box	171.96 sq. ft.
Heating surface, total	2445.26 sq. ft.
Grate surface	30.71 sq. ft.
Exhaust pipes	Single
Exhaust nozzles	5¼ ins., 5½ ins., 5¾ ins. diameter
Smoke stack, inside diameter	16⅛ ins. by 14¼ ins.
Smoke stack, top above rail	14 ft. 5¾ ins.
Tender.	
Weight, empty	50,500 lbs.
Wheels, diameter	40 ins.
Journals, diameter and length	5½ ins. diameter by 10 ins.
Wheel base	17 ft. 4½ ins.
Tender frame	10-in. steel channels
Water capacity	5,000 imp. U. S. gallons
Coal capacity	7½ tons
Total wheel base of engine and tender	54 ft. 6 ins.



High Pressure Valve and Bushing.

Two-Cylinder Compound Ten-wheel Locomotive.—Canadian Pacific Railway.

NEW LOCOMOTIVE AND CAR SHOPS.

Collinwood, Ohio.

Lake Shore & Michigan Southern Railway.

III.

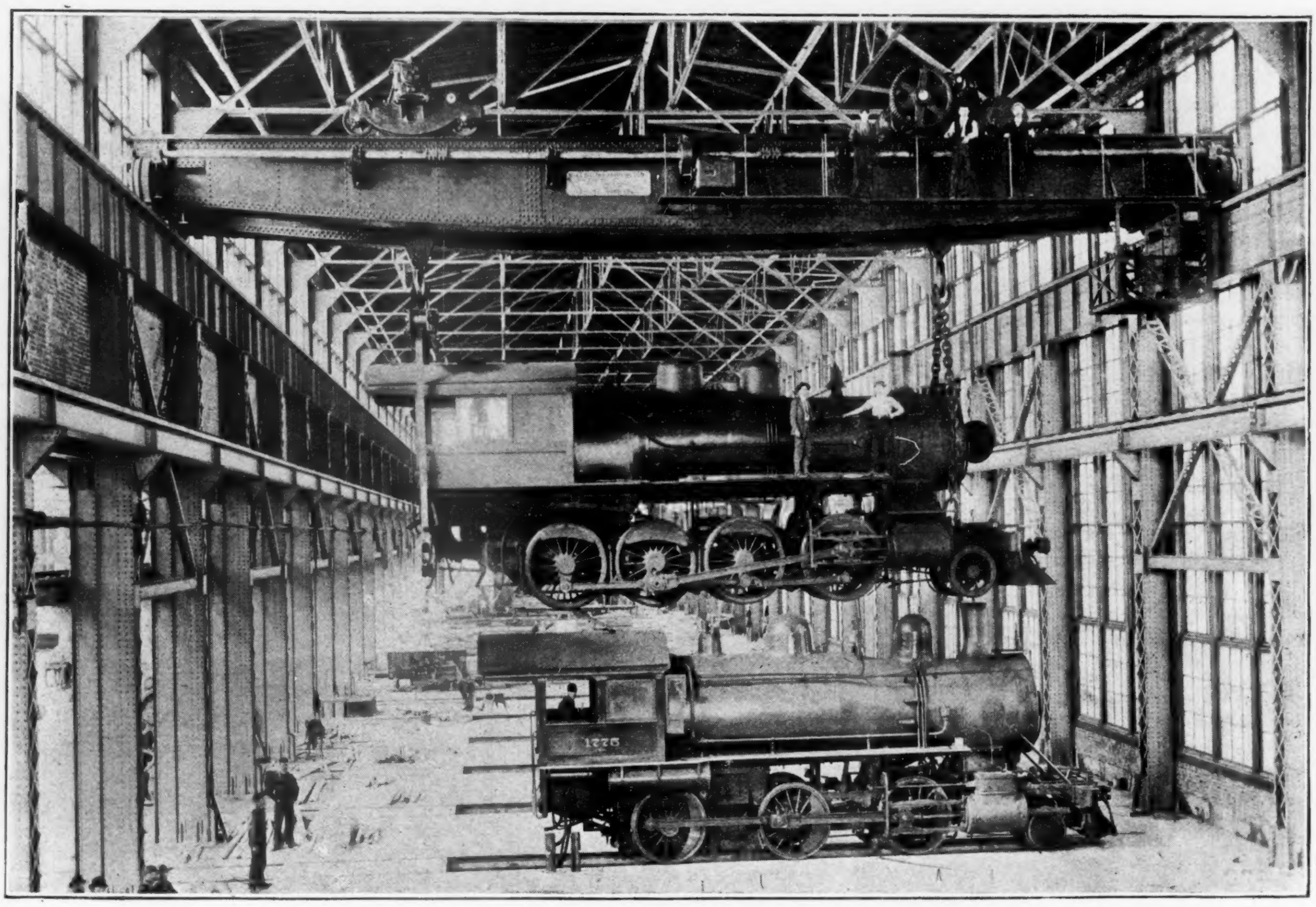
The Locomotive Shop Building.

On pages 300 and 301 of our October issue exterior views and a section of the locomotive shops of the Collinwood plant of the Lake Shore & Michigan Southern Railway were presented, together with interior and exterior construction views. In this number additional details of interest are shown with regard both to the side framing and to the roof construction, and also the equipment of the building. The framing supports are substantial steel piers placed on ample foundations of stone; they are designed of plates and angles in such a way as to support the roof and the crane girders independently, and also provide for the window framing. In the detail views on page 367 the dimensions and construction of the piers are clearly shown. These were designed with reference to simplifying the construction by using 23 units exactly alike in the outside wall of the erecting shop and making the units of the other walls so that they also could be alike along the entire length of the building.

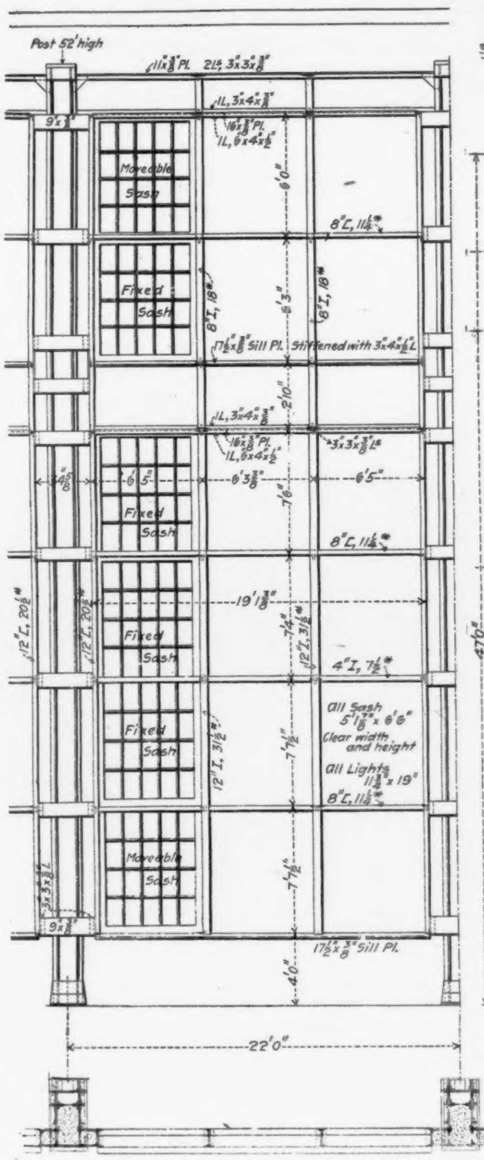
In the outside walls there are two intermediates between the main piers, with 12-in. mullions for the windows. The glass of the windows begins 4 ft. from the bottom of the wall, and there are about 30 ft. of glass here and then 3 ft. of brick wall, surmounted by 12 ft. 6 ins. more of glass. The support of this intermediate brick wall and the one in the division wall on the opposite side of the erecting shop is shown in one of the detail engravings, and the large proportion of glass in this building relative to the wall area was stated in the table on page 304 of the October number. The large side window areas are 19 x 30 ft. each in the lower sections and 19 x 12 ft. each above, these being repeated the entire length of the building. The windows in the top of the division wall between the erecting and machine shops, above the intermediate section of brick, are 19 x 12 ft. each, repeated the entire length, as on the opposite side. The details of construction of both the side framing and the windows of the erecting shop are very clearly shown in the interior view below and on page 367.

The steel work is provided with bracing in alternate bays, with expansion bays between, like a trestle. At the end of the boiler shop is a 30 x 35-ft. riveting tower, carried on a special roof truss extending across the building, and on a box girder reaching the length of two bays longitudinally. In the entire building the steel work was erected independently of the brick work. In the detail drawing of the steel columns the particular care in arranging the size to exactly take the brick facing is made evident, as is also the method of filling the columns with concrete, which is of a mixture of one part of cement to eight parts of combined sand and gravel.

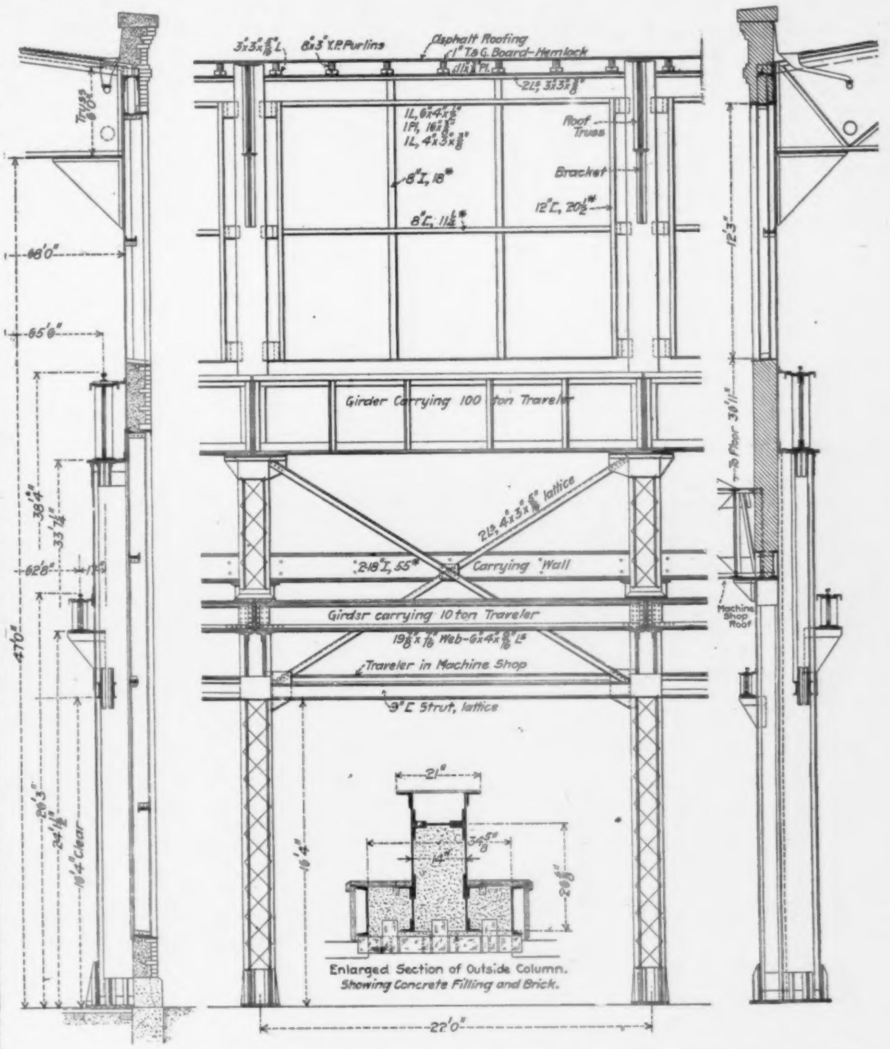
Another detail view, on page 369, illustrates the roof drainage with inside rain conductors. The angle made by the edge of the roof with the wall has a ridge at each end and at alternate panels; leaders are placed at the first, third, fifth, etc., panels, terminating in gutter boxes. As may be seen, the gutter boxes are 10-in. boxes made of 16-oz. copper with flash-



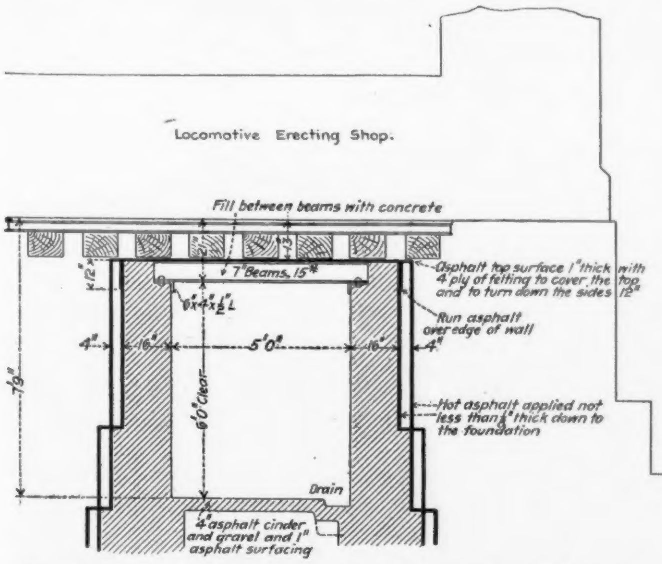
View of 80-ton Locomotive Lifted by Crane in Erecting Shop.
Collinwood Shops. — Lake Shore & Michigan Southern Railway.



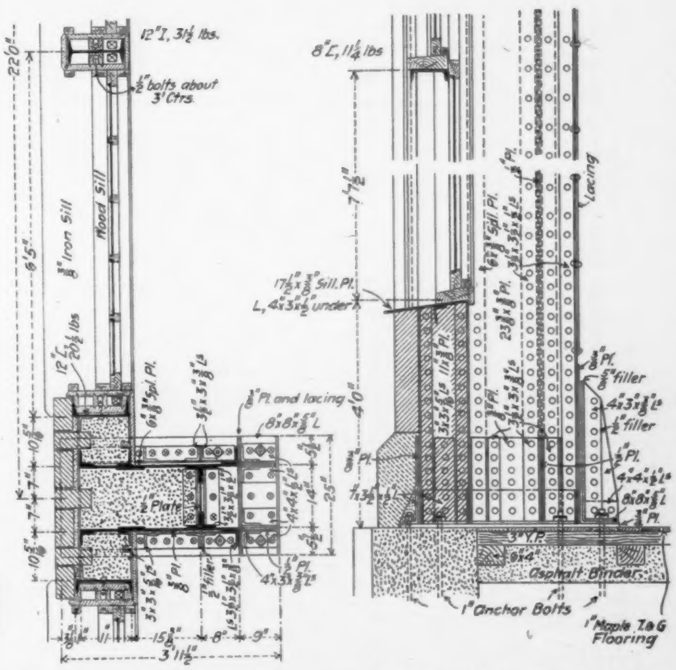
Details of Framing Unit, South Side of Erecting Shop, Showing Arrangement of Window Framing.



Details of Framing Unit, North Side of Erecting Shop, Showing Method of Supporting Intermediate Brick Wall.



Cross-Section of Piping and Wiring Tunnel Where It Enters Locomotive Shop.



Detail Drawings of Steel Columns Indicating Concrete Filling and Method of Arranging Brick Facing.

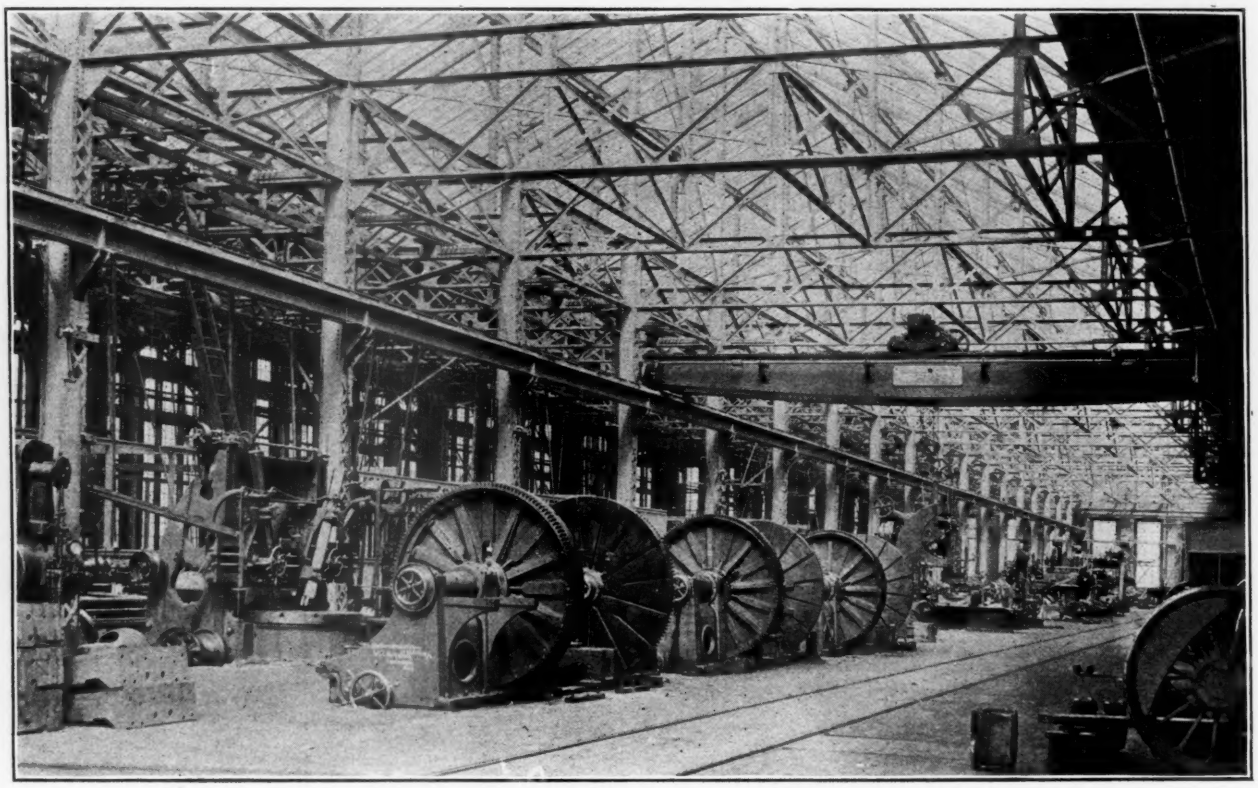
Collinwood Shops. — Lake Shore & Michigan Southern Railway.

ings extending 18 ins. on each side of the opening in the roof and underneath the roofing felt. Each box is provided with a copper wire screen to prevent entrance of gravel or obstructions into the leaders, to which they are connected by large tapering copper pipes leading down with easy bends into a 4-in. nipple screwed into the tee in the main leader of 4-in. W. I. pipe. This arrangement of inside drainage entirely obviates the difficulties usually met with the freezing of rain headers in winter.

Floor Plan.

On pages 370 and 371 are engravings of the floor plan of the locomotive repair shop showing the arrangement of machinery in the machine and boiler shop sections. Immediately to the north of the middle longitudinal track is the heavy tool section of the machine shop, which is served by a 7½-ton Niles crane with a span of 46 ft. 7⅞ ins., while the other half of the machine shop to the north adjoining the boiler shop is the more, the single erecting-shop crane, as used in this arrangement, is more convenient for handling the locomotives than the two required by the longitudinal arrangement.

It was contended by the officers of this road that the machine and erecting shop of a locomotive repair shop should be almost as wide for a small number of engines as for a large number, but that in shops of the magnitude of these a great deal of outside work is likely to be taken in for other departments, so that they must necessarily be larger if it is desired to avoid duplication of special machinery at other points of the system. In carrying out this commendable idea, it is interesting to note that the erecting shop was made 68 ft. wide and each bay of the machine shop 50 ft. wide, making the total shop, exclusive of the boiler and tank shop, 168 ft. wide; this is of interest in comparison with other notable railroad shops—the width of the erecting and machine shop of the Oelwein shops of the Chicago Great Western Rail-



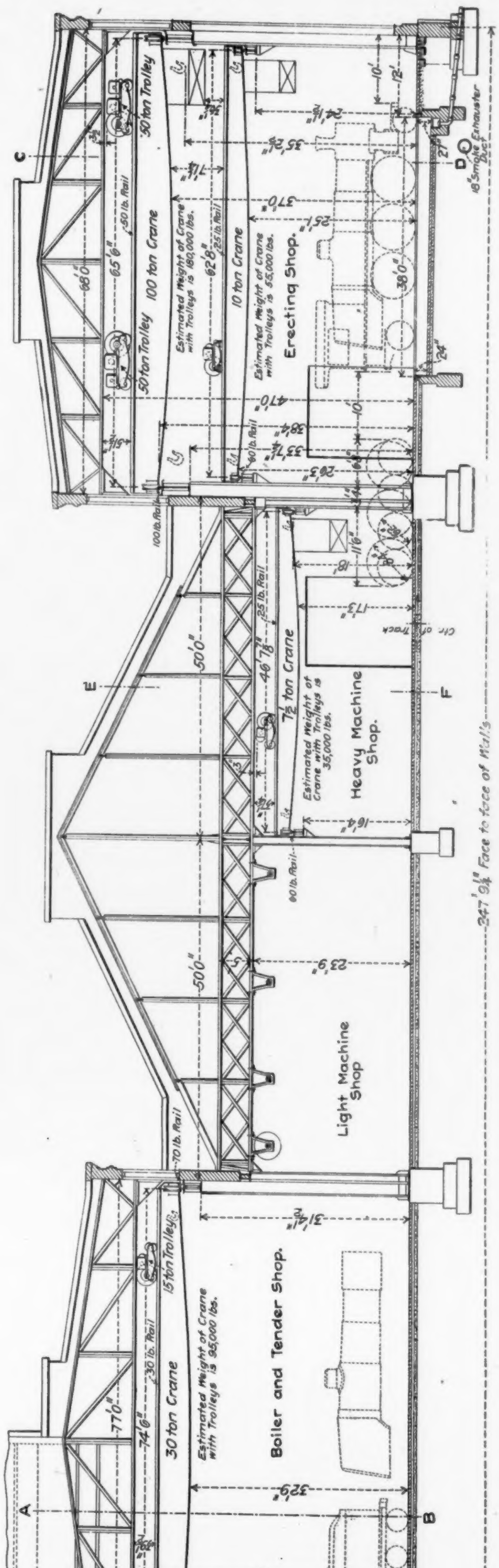
General View in Machine Shop, Heavy Tool Section.
(84-Inch Niles Driving Wheel Lathes in Foreground.)
Collinwood Shops.—Lake Shore & Michigan Southern Railway

light machinery section. The latter section of the shop is not provided with a large long-span crane, being left with free overhead space to provide for the use of countershafting for the group-driven machine tools with the exception of three short 17 and 18 ft. span cranes, each with limited travel, serving a few groups of machines only; in this bay the tool rooms are located, as well as also the lavatory and locker compartments, which partially project into the boiler shop. This floor plan illustrates better than is otherwise possible the real advantages of the proximity of the heavy tool section to the erecting shop—the distance from the center of the erecting shop to the center of the heavy tool section is only 59 ft. and the large driving-wheel lathes, the frame slotters and the frame planer are all located toward the erecting-shop side of the bay. The commendable feature of the arrangement of this shop is the concentration of all the locomotive work under one roof; also the fact of having no pits to cross, and that of the engines remaining always in the same place until completed, are advantages of no little importance, and further-way is 90 ft. only, and that of the Hannibal shops of the Chicago, Burlington & Quincy Railroad is 98 ft.

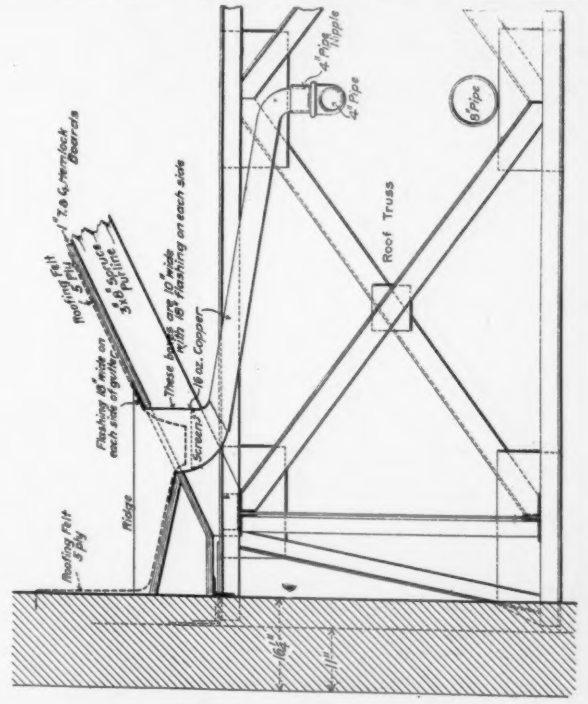
Heating and Ventilating System.

The heating and ventilating systems of the shop buildings are all hot-air fan blower systems delivering air through conduits under the floor. No return system is provided, as the fans are located within their respective buildings and take their air from within.

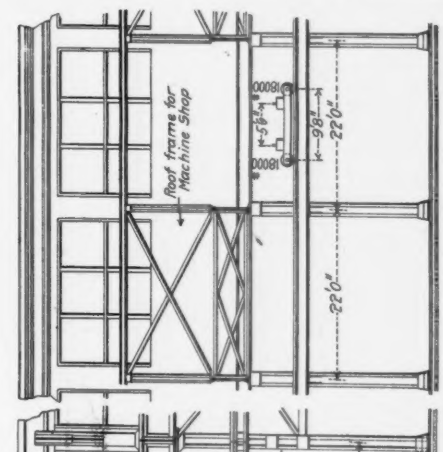
There are two of the direct-connected fan units in the locomotive shop building, one located near the center of the west half and the other near the center of the east half of the building, and each unit forces air into four delivery conduits leading toward the edges of its half of the building. The outlet openings are of galvanized iron pipe, 24 ins. in diameter, with two 17-in. openings for those along the edges of the building and 22 ins. for those by the center columns in the machinery section, and are all provided with dampers for shutting off the flow of air. The diagram indicates fully the arrangement and



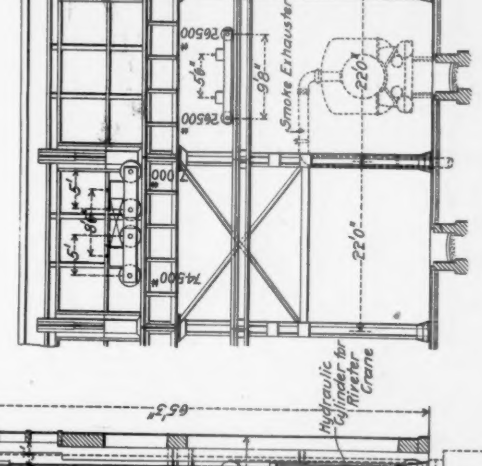
Cross Section Through Boiler, Machine and Erecting Shops, Showing Arrangement of Cranes and of Shafting Supports.



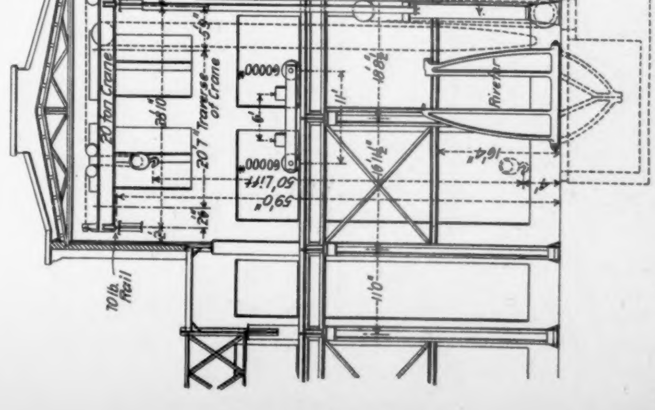
Detail of Roof Connections for Inside Drainage.



Section in Machine Shop,
To Show Roof Framing.

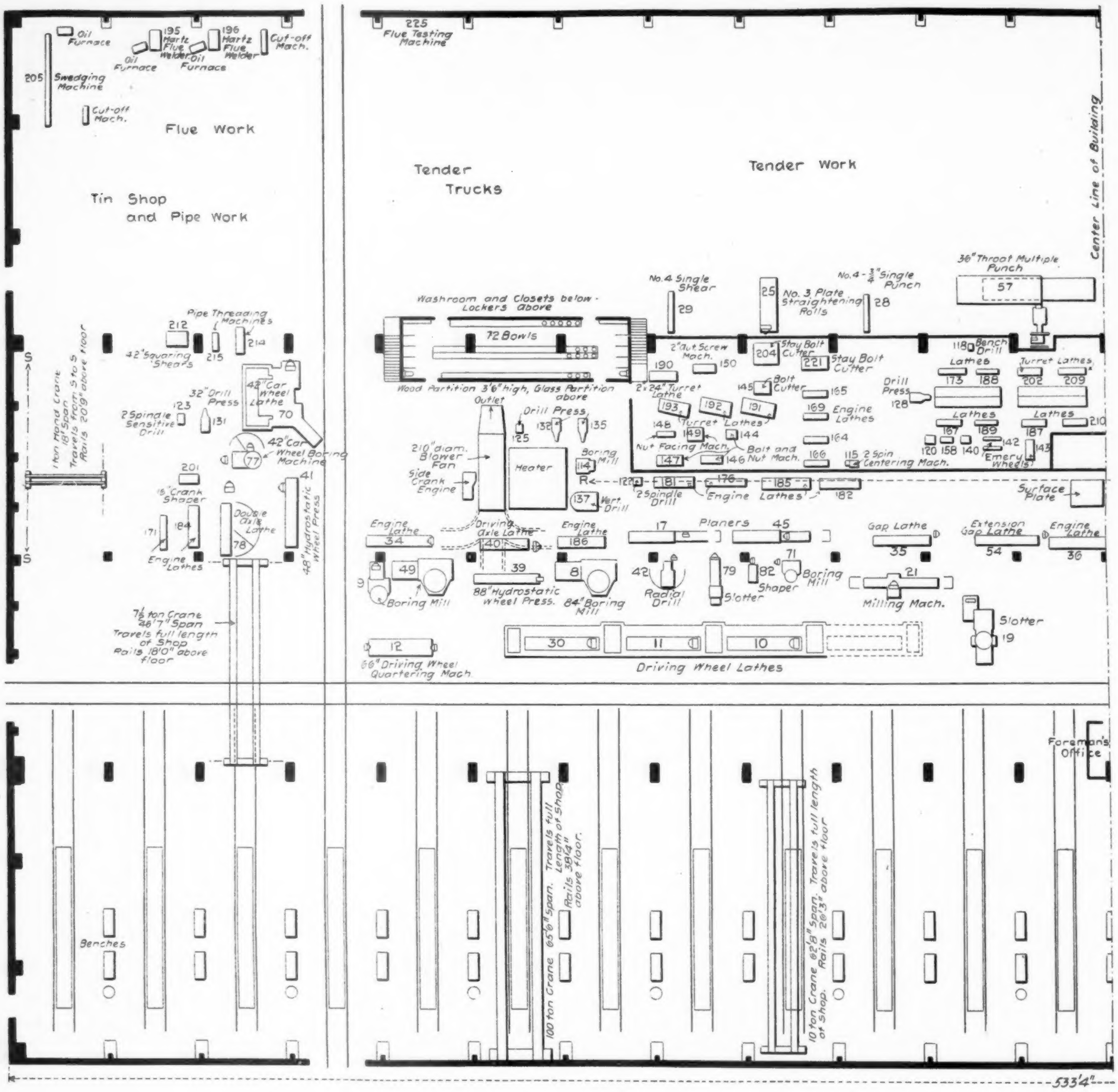


Section in Erecting Shop,
To Show Framing Units.



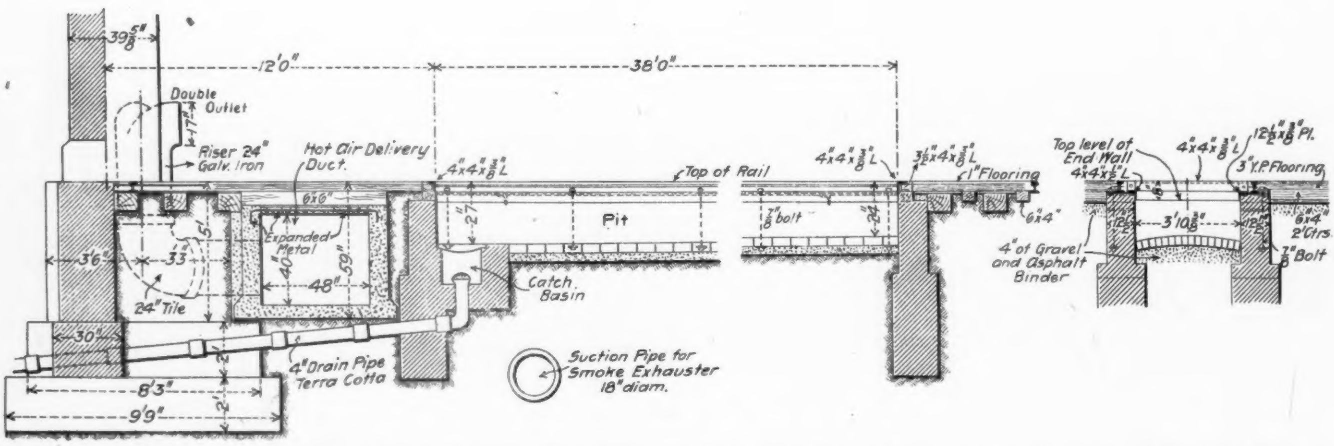
Section through Riveting Tower

Collinwood Shops.—Lake Shore & Michigan Southern Railway.



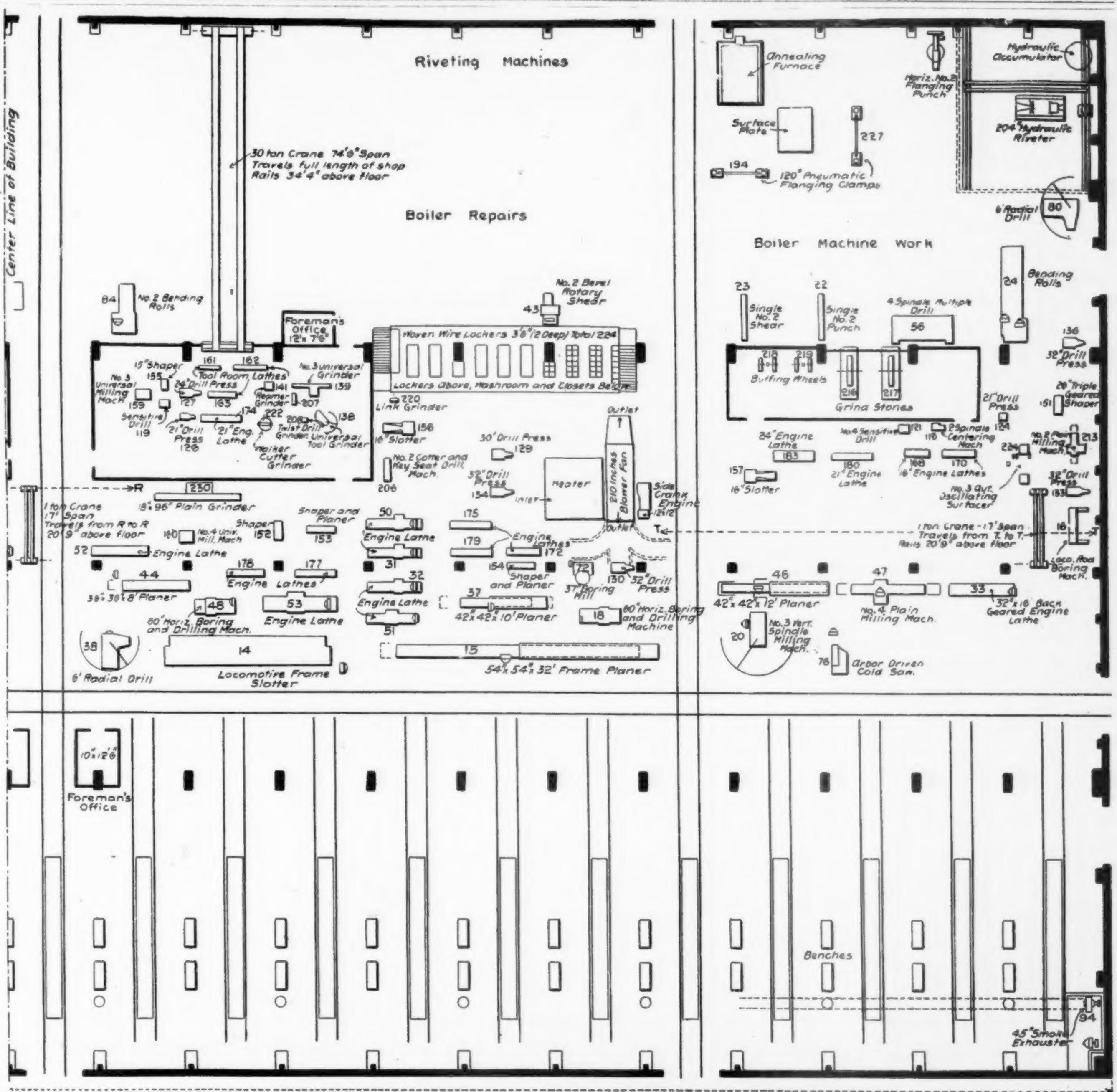
Floor Plan of Locomotive Shops, Showing Arrangement of Machinery.

(The other half of this plan is on opposite side.)

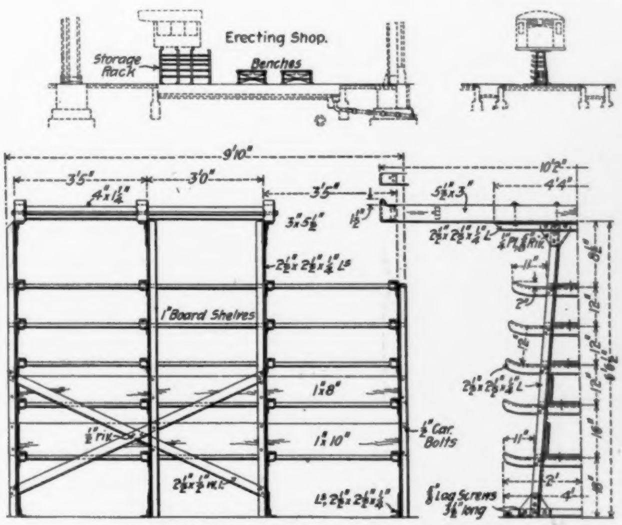


Detail of Engine Pits in Erecting Shop Construction of Hot Air Ducts and Outlet Connections Indicated Near South Wall.

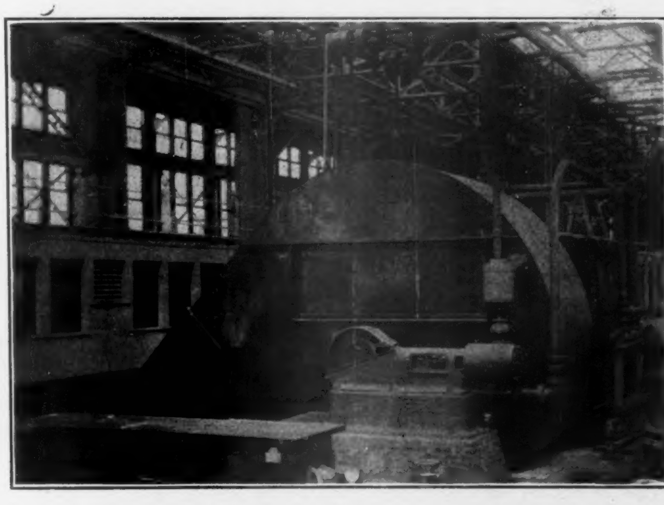
Collinwood Shops. — Lake Shore & Michigan Southern Railway.



Floor Plan of Locomotive Shops, Showing Arrangement of Machinery.
The other half of this plan is on opposite page.)



Details of Racks between Pits in Erecting Shop.



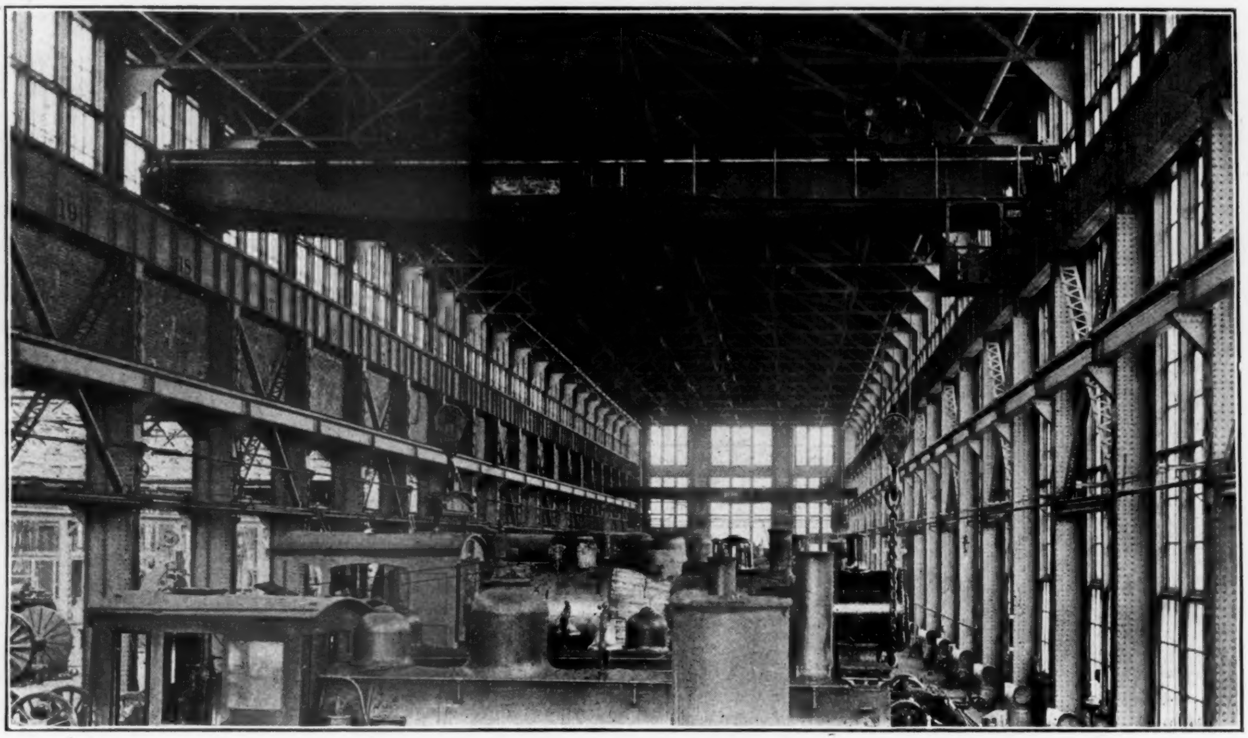
View of the 148-Inch Blower Fan in Machine Shop
Lavatory Compartment at Left.

Collinwood Shops. — Lake Shore & Michigan Southern Railway.

general dimensions of the branch conduits, while the photograph of the erecting shop and cranes below shows at the right a group of the double-outlet openings along the wall of the building.

The conduits are of concrete construction for the larger sections, the top walls being 2½ ins. thick, reinforced and stayed by a core of expanded metal; where tracks cross the flues the walls are thickened for about 10 ft. In the construction the tops of the flues were depressed so that the plank coverings of the floors do not rest on them. The smaller flues and outlet openings are of circular terra-cotta tile, which lead to the floor openings over which are the galvanized discharge pipes.

The fans are each of the three-quarter-housed-pattern steel plate type, with wheels 143 ins. in diameter and 72½ ins. wide, and each fan is direct-driven by a 12 by 12 in. 40 horse-power horizontal sidecrank engine running at 110 r. p. m. Each heater has 20 sections of pipe coils, each 7 ft. by 8 ft. by 10 ins., and each connected individually to the steam supply through a valve, permitting cutting in or out; in this way the temperature of the air delivered may be adjusted at will. Each section has mounted two rows of 1-in. pipe, the combined capacity of the two heaters being 25,320 ft. of 1-in. pipe. The system is guaranteed to maintain the temperature of the building constant at 60 deg. F. during the coldest weather. The engines, fans and heaters were all furnished by the Buffalo Forge Company, Buffalo, N. Y.



General View of Erecting Shop, Showing 10-Ton and 100-Ton Cranes.
(Air Delivery Outlets Appearing on Floor at Right.)

Locomotive Shops.—Lake Shore & Michigan Southern Railway.

Along the entire length of the erecting shop under the outer ends of the pits is an 18-in. smoke-exhauster duct, with 18-in. branches to floor openings between alternate pits. To these the stacks of locomotives are connected by removable sections of galvanized pipes; in firing up the smoke is exhausted through a motor-driven fan at tl east end of the building.

Piping Systems.

The question of accessibility was solved by the construction of piping tunnels from the basement of the power-house to the various shop buildings, a section of the one leading to the locomotive shop having been illustrated on page 335 of our preceding November issue. Its construction of concrete, with suitable waterproofing, renders it perfectly dry and clean and thus suitable for electric conductors; a detail drawing on page 367 shows this construction by a section where it enters the locomotive shop building. The entire exterior surface is thoroughly waterproofed by a coating of asphalt applied while hot to a thickness of ⅛ in., and the top is covered by roofing felt laid four-ply, each layer in hot asphalt, and turned down 12 ins. over the sides. The concrete top of the tunnel is reinforced and stayed by 15-lb. 7-in. I-beams spaced 24 ins. between centers. High-pressure steam is used in the locomotive shop building for driving the ventilating blower fans, its use for that purpose having been thought preferable to an electric motor drive solely for the reason that with the steam engine its exhaust is available for very economically supplying the heater coils for the hot-air system. The high-pressure steam line consists of 5-in. wrought-iron pipe with screwed flange connections, suspended by swinging loops from brackets in the tunnel, and enters the engines through Cochrane steam separators of the vertical type located just above the engines.

The exhaust pipe leading to the power-house is an 8-in. pipe with screwed flanged connections and supported by the special swinging-link hanger supports that were illustrated upon page 335 of our November issue. This pipe may be used for conveying the exhaust from the blower engines back to the power-house if so desired, but will more probably be used for supplementing the steam supply to the heater coils by bringing over the exhaust from the engines and pumps in the power-house and from the steam hammers in the smith shop. This pipe connects to the large exhaust header in the power-house basement through an oil separator for preventing as much oil from entering the pipe line as possible. Also, a live steam connection is made to the exhaust system in the power-house for supplementing the combined exhausts in supplying the heater coils if found necessary in the coldest winter weather; the live steam is arranged to be admitted through two reducing

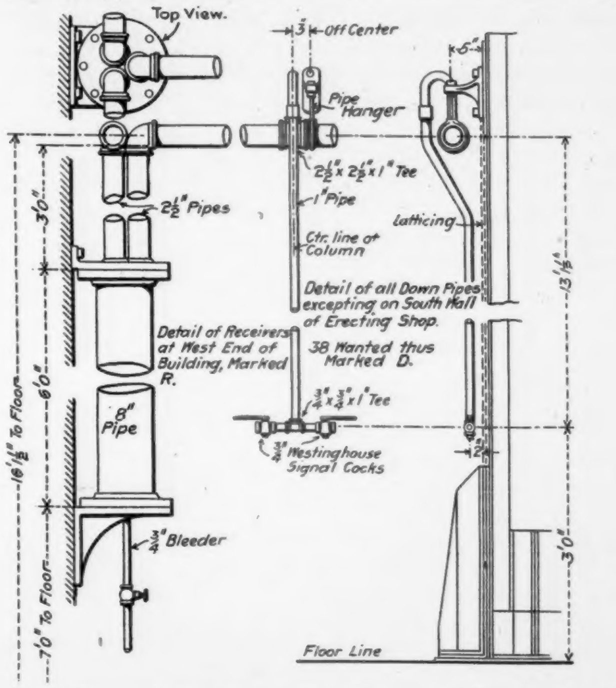
valves, the first reducing down to 40 lbs. and the second down to the exhaust line pressure.

The method of calculating the sizes of steam pipes required between the power-house and locomotive shop is interesting. The high-pressure steam line was calculated from the full-load steam consumption of the blower engines as stated by the makers, allowing a drop of pressure of 25 lbs. between the power-house and engine, and the exhaust pipe was calculated for the maximum flow from power-house necessary, as stated by the makers of the heater, to supply the heater coils under the worst conditions, after deducting, of course, that supplied from the exhaust of the engine itself. The formula used is as follows:

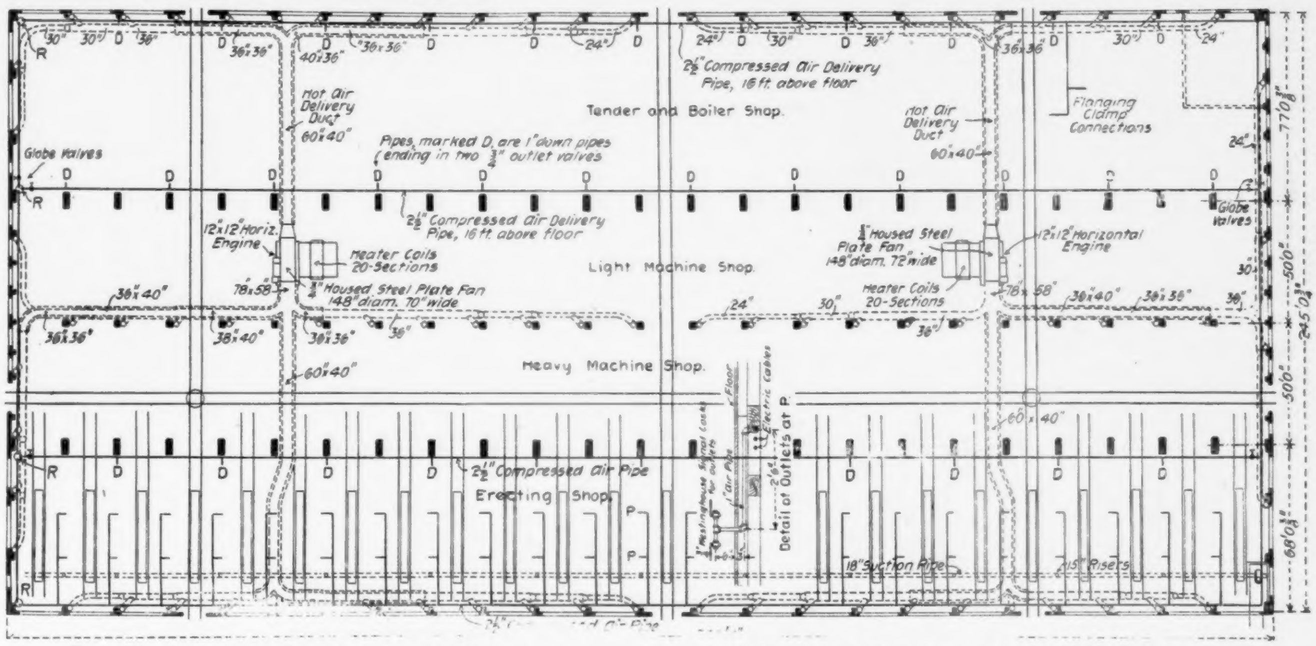
$$W = 87\sqrt{\frac{w\,(p' - p'')\,d^5}{L\left(1 + \frac{3.6}{d}\right)}}$$

where W = Weight of steam flowing in pounds per minute;
w = Weight of steam per cubic foot at pressure, p';
p' = Pressure in pounds per square inch at entrance to pipe;
p'' = Pressure in pounds per square inch at delivery end of pipe;
d = Diameter of pipe in inches; and
L = Length of pipe in feet.

This formula has been found to give very satisfactory results and was used throughout the Collinwood plant.



Details of Reservoirs and Down Pipe Connections for Outlets in Compressed Air Piping.



Floor P an of Locomotive Shops, Indicating Arrangement of Hot Air Ducts and Outlets, and also Compressed Air Piping. Collinwood Shops.—Lake Shore & Michigan Southern Railway.

Compressed air is delivered to the locomotive shop through a 4-in. pipe with screwed flange connections which is suspended by swinging loop supports from the brackets in the tunnel. At the entrance to the building it is led up to connect with the 2½-in. distribution pipes which extend, at a distance of 16 ft. above the floor, entirely around the outside wall and along the two lines of main posts separating the main sections of the building, as shown in the diagram above. A detail of the outlet under one of the benches is also shown on the above diagram. Air reservoirs are located in the distribution piping at the junction of the pipe across the west end of the building, with each of four mains leading lengthwise. The valves and all the fittings for the piping were furnished by the Crane Co., Chicago, Ill., the well-known manufacturers of high-grade steam supplies; all 2-in. valves and smaller are brass valves, and those larger than 2 ins. are of iron body, brass trimmed.

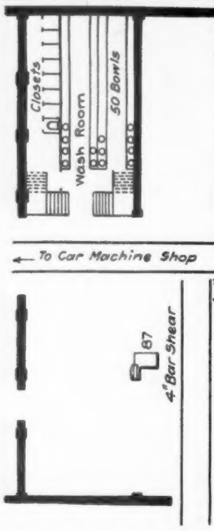
Lavatories and Closets.

The lavatories and closets, as well as the employees' lockers, are provided for by two small two-story buildings or compartments, 15 by 56 ft., within the main building located upon the division line between the machine and boiler shops, one near the west center and the other near the east center of the building. The lower story of the compartment, which is 3½ ft. above the floor of the shop, contains four rows of wash basins, 72 bowls, in the central portion, and in each end are four water closets and a bank of urinals. Cleanliness and the best sanitary conditions are provided for by a slate floor and the best open plumbing. Hot water is supplied from the power house by a pair of circulating pipes keeping it always hot. A pair of stairs at each end of the compartment leads up to the upper floor, 8 ft. above the lower one, upon which are located 11 rows of lockers of the expanded metal type, furnished by Merritt & Co., Philadelphia; the lockers are 3 ft. 6 ins. high,

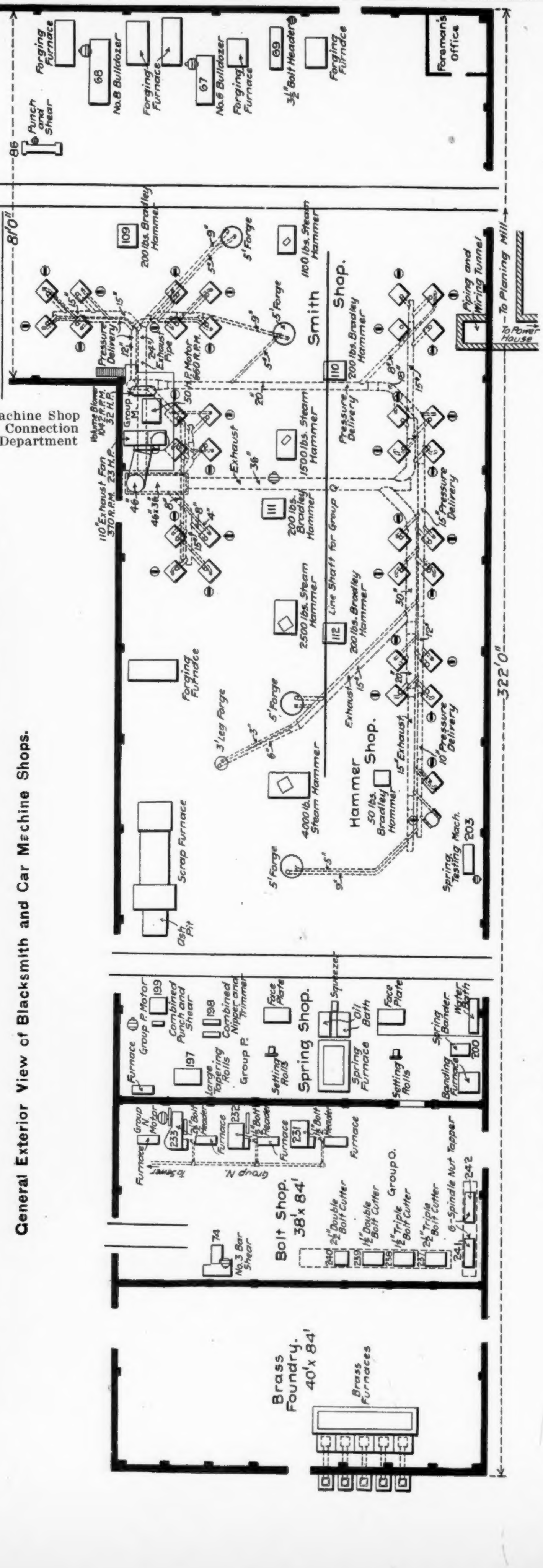
each, and are arranged in tiers, two high, one above the other, there being in all 224 lockers in each compartment. A partial view of these compartments is shown at the rear of the blower fan in the view on page 371.

Handling of Work.

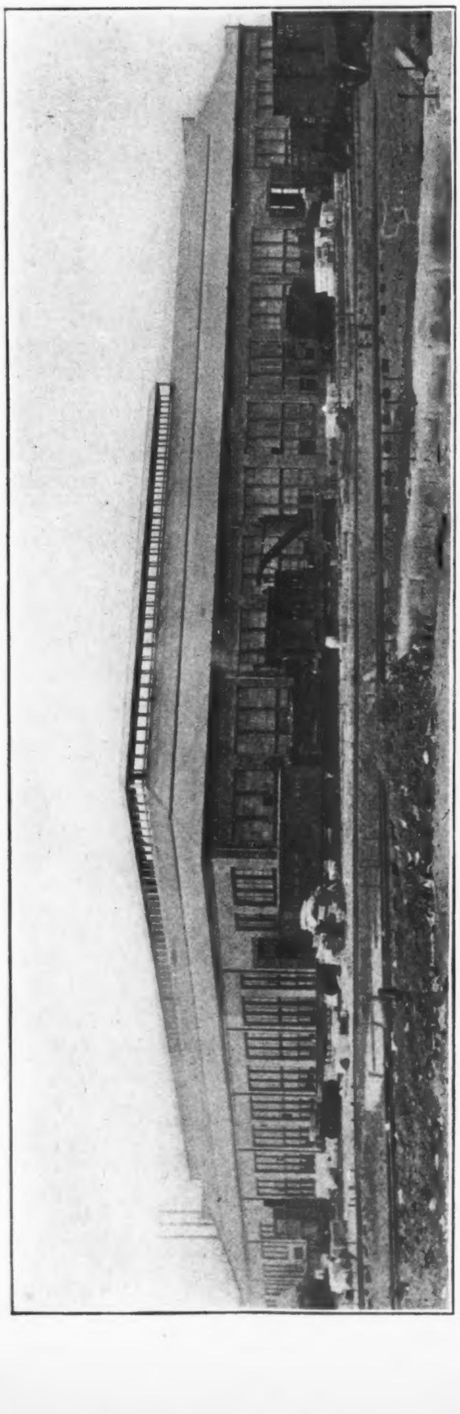
Storage tracks are located north of the boiler shop for skeletons of locomotives which have had their boilers removed for the application of new fireboxes, and also for locomotives and tenders, and the engine and tender truck wheel storage tracks are there also. Engines enter into and come out of the shop by means of an electrically operated turntable located north of boiler shop and midway between its ends.



Floor Plan of Car Machine Shop Will Appear in Connection with the Car-Department Buildings.



Floor Plan of Brass Foundry, Bolt and Spring Shops and Blacksmith Shop, showing Arrangement of Machinery. Collinwood Shops. — Lake Shore & Michigan Southern Railway.



General Exterior View of Blacksmith and Car Machine Shops.

Tenders are disconnected from their locomotives outside of shop, and by means of the pony engine the locomotive is put on turntable and then into the shop. No stripping is done on center or entering track; the engine, immediately after entering, is lifted by the large crane and set on a shop pit designated in advance for this particular engine.

The "stripping" gang then takes it in hand and before the cranes are lowered the pedestal caps, spring rigging, braces, etc. (that are necessary for the removal of drivers and trucks), are taken down; then the engine is raised and the driving wheels rolled out (without removal of rods, except back-end and main ones) toward the back of the engine and engine truck rolled out forward.

"Baskets" of steel, holding all the parts of one small locomotive, or one-half those of a large one, are placed nearby, so that the work destined to go to the cleaning vats may be immediately placed in them and the whole thing handled with the crane to a truck; then it is taken to the vats outside, where another crane places the baskets containing the material in the cleaning liquid, and with the cover put on the whole thing is ready to steam. After steaming, the basket is removed and the perforated bottom drains out all the liquid, after which the material has only to be washed off with a convenient water hose and it is ready for distribution to the different departments.

One gang handles all the rods; another the pistons and crossheads; another the rockers, reverse shaft, links, reverse lever, throttle levers, etc.; another the driving boxes, eccentrics and straps; another steam pipes; another the boiler mountings; another the air brakes, etc. The distribution of the material is, of course, made to these different gangs.

When the work for any engine that is assigned to any gang has been completed it is sent at once to its corresponding engine in the erecting shop and placed on the racks provided for it; in this way the erecting department knows that what material is not on hand is not completed. The machinery for doing the particular work assigned to each gang is in all cases located conveniently for that gang.

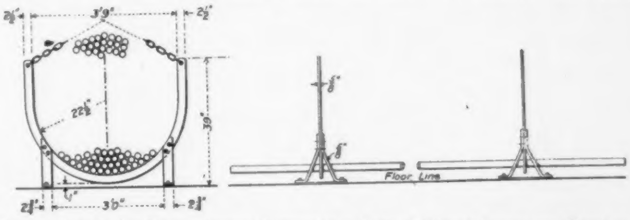
It may here be stated that renewals of small parts are furnished from storehouse stock, and no attempt is made to manufacture small articles for each engine individually. Rather they are drawn on "shop orders" from stock as needed, both for outlying points and for use at the central shops. In all cases the same men duplicate their work, and each individual does the same work over and over, so that it is done expeditiously and cheaply. For instance, one man does all valve setting; just as few as possible fit all driving boxes; still others fit up shoes and wedges, etc.

There is one general foreman; one foreman having general charge of all boiler work, with assistants as needed; one shop foreman in the machine shop, with an asistant; a rod-gang foreman; a motion-gang foreman; a piston-gang foreman; a wheel-gang foreman; one shop foreman, with assistant; a bolt-room foreman; a brass-room foreman; a tool-room foreman; one smith-shop foreman, with assistant in spring shop and bolt shop; one carpenter foreman; one copper-shop foreman, and one shop foreman in erecting shop, with six pit foremen. Pit foremen have just such regular men as are needed to do odd work. The steam-pipe gang goes from one engine to another, as scheduled; boiler-mounting gang does the same, as also the other gangs, these different gangs always doing their individual work, and while at work on any pit are directly under the supervision of the pit foreman having charge of that particular engine. The pit foremen are responsible to the erecting-shop foreman for good and economical work.

Engines are scheduled out the day they go into the shop, and if for any reason a delay should be foreseen, the individual who has charge of the department that may cause it is expected to report it in advance so that the general foreman may see to it that this particular part of the work is hurried along if possible.

Engines are fired up and "tested" before being lifted over onto the main track, and are immediately taken in charge by the trial engineer (who reports to general foreman) and moved out of shop. No trouble whatever is experienced from the fact that there is only one track for incoming and outgoing engines, as there is no delay whatever on this track, it taking but about ten minutes to take off an engine coming into the shop, and they are ready to move immediately on going out.

Flues are handled by the cranes in racks holding a complete set for each engine, both to and from the engines. The construction of the flue racks is shown by the accompanying sketch. The northwest corner of the shop is used for flue work. Outside of this shop there is one flue rattler for cleaning flues, which will take one full set of flues in and out, all without handling. After rattling, the flues are taken in the shop to the flue fires, where each flue is heated, cut off and swaged in one heat, ready for application to its boiler.



Crane Rack for Handling a Complete Set of Flues from an Engine.

Locomotives that are in the shop for fireboxes have the skeleton set on special trucks and are run outside while the firebox is being applied. All the work of the machinery is, of course, then being taken care of at the same time without taking up any pit room with the frames, cylinders, etc.

All heavy work can be handled from one shop to another by cranes and trucks. Each column in the erecting shop is provided with a portable crane so that one person can easily handle driving boxes in fitting them.

The storage location for the driving wheels is immediately behind each engine, so that when the eccentrics and straps and driving boxes have been fitted the wheels are in position to be rolled under the engine without extra handling.

Blacksmith Shop.

This building is in the shape of a letter L with a width of 80 ft. One wing contains the brass foundry, the bolt shop, spring hammer and smith shop and the car department machine shop fills the other wing; the latter will be described later in connection with the car department buildings which are not yet completed. This arrangement and the admirable location of the building permits of using the entire blacksmith shop equipment for both departments.

In the ground plan of this building the location of the forges and other equipment are shown and these will be included in the machinery list which is to appear next month. This shop is well lighted by numerous high windows and by skylights, shown in the photograph. The building is convenient to the iron racks, scrap bins and coal storage. The fires are arranged in groups of four, with a hydrant and coal supply for each group and each is convenient to a steam and a belted hammer as indicated in the plan. At the north end of this shop is a complete equipment of spring machinery. In the bolt shop there are five Furguson oil furnaces, there are three more in the spring shop and five in the blacksmith shop. In all there are 21 oil furnaces of this make in the plant. The furnaces and the oil distribution system will be described in another article.

Blast for the forges is supplied by blowers made by the Buffalo Forge Co., in the blacksmith, bolt, and spring shops. The forges are of the down draft type, finished by the same concern. The blower and exhauster for the forges are placed on an elevated platform at the corner of the shop and the ducts are under the floor where they are entirely out of the way. A 20 h. p. motor drives four Bradley 200 lbs. "Compact" hammer and one 50 lbs. hammer of the same make, in the blacksmith shop and, in addition 4,000 lbs., 2,500 lbs., 1,500 lbs., and 1,100 lbs. steam hammers are arranged in a line along the center of the shop. The drawing is so complete as to render further comment on this shop unnecessary.

(Established 1832.)

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Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

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PIECEWORK - A NECESSARY PRECAUTION.

In the movement toward commercializing railroad shop practice the payment for work done rather than for time expended is the foundation for improvement. This is nothing more nor less than piecework, the underlying principle of which has placed American industrial enterprises on their present successful basis. Piecework seems to be the only solution of the problem presented by the ever increasing demands of labor, because it seems to be impossible for corporations to raise wages much further without some corresponding increase in productivity. Paying for work done seems to meet this problem in a broad and fair way, for it gives a man an opportunity to benefit by his own efforts to increase his output, and the output of the machinery under his charge. That railroads must introduce piecework is generally admitted by those who are active in improving the motive power departments upon the plan of increased output at reduced cost.

It seems necessary, however, to again sound a warning against the method of introducing this system which has, it may be said, invariably led to failure and confusion. It cannot be successfully introduced without careful preliminary investigation and preparation. It should then be placed before the men in such a light as to lead them to desire it. The bulletin board notice to the effect that this system will go into effect for entire departments on a certain date is the wrong way. Placing the problem in the hands of a competent, trained, experienced piecework expert, who will study the local conditions and move only as rapidly as he is sure of his ground, is the right way, and to make his success possible and permanent thorough confidence in this individual on the part of the men is absolutely essential. Next to this must come an absolute and unswerving support of the principle of piecework from the management and no corporation is ready for this movement until these preliminaries are correctly arranged.

Price fixing is the difficult problem in starting piecework as the prices must be correct or they will need to be changed and the changing has been the cause of so many failures in the past. This work requires a special and peculiar experience and men are greatly in demand who have the necessary qualifications. Fortunately they are increasing in numbers but not fast enough to meet the requirements. At the present stage of this question it would seem advisable to provide for the training of men for this work. They need to understand men, to be fully informed as to the capabilities of men, the capacities of machines, the merits of tool steel and the possibilities of the removal of material with respect to feeds and speeds. The acquirement of such qualifications requires time and it is not to be admitted that railroad officers will neglect to make this preparation.

FRENCH FOUR-CYLINDER COMPOUNDS.

A gentleman whose name is known widely in the locomotive world happened to call at the editorial rooms of this journal when the proofs of Mr. Herdner's article (in this issue) came from the composing room. After reading it carefully and examining the drawings, he said:

"I wish to congratulate you upon obtaining so splendid an article for your paper. I believe it to be the most valuable addition to the contemporary literature on the compound locomotive."

Our desire is not to induce the reader to swallow French practice "whole," but to lead to a study of the high development of the compound locomotive which has been reached in France.

Mr. Herdner has something interesting to say about the crank axle, and he also disposes of the question of complication. But a French view of complication will hardly find a hearty response in this country. The proper way to look at this question is whether American locomotives are complicated enough. Is it not possible to simplify construction to a degree which imposes stresses on a small number of parts, which they cannot withstand because they cannot be made large enough? Has not this been done in this country, and is there not a lesson to be learned through the increasing frequency of frame and cylinder breakages?

It is to be hoped that someone will try the De Glehn principle or an Americanized application of its fundamental features.

PRIZE PAPERS FOR A RAILWAY CLUB.

The prizes offered by the Pacific Coast Railway Club for papers pertaining to the construction, equipment, maintenance and management of steam railways should flood the office of the secretary with literature. The writer of this paragraph was for a time secretary of a railway club, and knows how difficult it is to secure good papers from the members. This should not be so, and it would not be if young men in railroad service could be brought to understand the value to themselves which a well-considered discussion of an important subject will bring. There is nothing more sure and more

satisfying than the result of a good paper before a railroad club, and officers should encourage their subordinates to work in their clubs as a duty. No one knows so well how he stands on a subject with which he may be familiar as he does after having written something about it which is to be read and criticised. The mere writing of the paper helps the young man to understand himself and, what is not less important, it helps others to understand him. Ability alone does not guarantee success. Acquaintance and reputation must accompany it, and how many of the well-known officers of mechanical and engineering departments of to-day owe their success to what they have written! The Pacific Coast Railway Club offers money prizes, but these are really insignificant in comparison with the prizes which are everywhere awaiting young men who have the knowledge and the energy to prepare papers for technical organizations and articles for the technical press. It is to be hoped that this club's effort will be successful. The papers must be from members of some railway club and they must be in the hands of the secretary, Mr. C. C. Borton, 1213 Twelfth street, Oakland, Cal., on or before January 1, 1903. The first prize is $100, the second $75, the third $50 and the fourth $25. The action of the club is commendable, but it is surprising that it should be necessary.

WHAT MOTIVE POWER OFFICERS ARE THINKING ABOUT.

Editorial Correspondence.

The most engrossing subject just now is the demand for locomotives. This concerns the East, West, North and South, and the condition is unprecedented. On one of the roads in the Northwest 48 locomotives sufficed for one of the heavy grain-carrying divisions last year. This year 147 will not handle the business, and 1,800 cars are now waiting on side-tracks. The locomotive builders, in spite of greatly increased productive capacity, are coming to the relief but tardily, because the traffic is enormous.

At such a time every factor tending to increase mileage is of vital importance. Every possibility of reducing the dead time of locomotives is considered, and these efforts have brought the subject of water purification into a prominence which it never before occupied. One general manager stated that this is now the most serious operating problem in bad-water districts because of the effects of the loss of time in boiler washing and boiler repairs. He also said: "The purification of feed-water is the most interesting and far-reaching problem concerning motive power departments to-day. Not on the score of economy alone, but because engines cannot be spared to wash or tinker boilers."

At present no road has enough purifying plants to represent the possibilities of purification. If but one of several water stations on a division is equipped with a plant its effects on boiler repairs will not appear to advantage, because the treated water is mixed in the tender with untreated water. Only when entire divisions are equipped can comparisons be made.

On one of the large Western roads having both good and bad water districts the following conditions represent the serious character of the water difficulty: On a good-water division engines 12 years old are still running with their original fireboxes, and the life of fireboxes averages more than 10 years. Flues give a mileage of 150,000, and after a little caulking are good for about as much more. In a bad-water district new half side sheets are necessary every year and new fireboxes every two years, the average condition requiring new half side sheets every two years and new fireboxes every four years. Flue mileage varies greatly, and in accordance with conditions which are sometimes puzzling. In bad-water districts they seldom last on this road for more than 55,000 miles before it is necessary to renew half of them. Frequently all the flues are taken out short of this mileage. These figures concern the cost of repairs. The necessity for washing boilers is perhaps more important. On the road referred to, all boilers are expected to be washed out every 10 days, but in the bad-water territory this is done for every 400 miles run. The actual time required is about five or six hours, but the boilers necessarily suffer under such practice, as they cannot be cooled down for washing as they ought to be in less than about 12 hours. Here is the strong argument for water purification, and among men who are doing their utmost to move freight this needs no elaboration. It would pay to spend a large amount to get water which would permit of renewing flues only twice in 10 years; not because of the flues alone, but because of reducing the dead time of the equipment. On the road mentioned, the mileage per engine failure averages 5,000 on the bad-water divisions and 16,000 on those having good water. Out of 450 engine failures for one month, 145 were due to leaky flues and fireboxes caused by bad water. In all of these cases engines of the same classes, using the same coal and making almost the same ton-mileage, were selected.

On another road, reaching far into the West, a worse condition was found. On a 200-mile division the boilers are washed out every round trip and the fireboxes of 12 new passenger engines are ruined in six months. Due to the water, each of these engines spends about two months out of every year in the shops, not considering the repairs to flues in the roundhouse. In this case flues are renewed four times a year. At one point a water is found which merits a monument. It has the following remarkable characteristics:

	Grains per Gallon.
Calcium Sulphate	26.04
Calcium Chloride	104.36
Sodium Chloride	249.13
Other Deviltry	7.47
Incrusting Solids	135.67
Non-Incrusting Solids	251.43
Total Solids	387.00

Its by-products would be very valuable. Is there any reason why such water should not foam or scale boilers? In 1,000 gallons of it there are 19.38 lbs. of incrusting solids. Of course such water is not used. Better water is hauled 37 miles up a 1 per cent. grade at a cost of 30 cents per 1,000 gallons for use at this point. This water traffic requires the constant service of one engine and twenty tank cars to supply 100,000 gallons per day. Such water cannot be purified in any way except by distillation. This serves to indicate the character of the water problem.

On one division of this road 1½ tons of incrusting solids are taken into locomotive boilers every day at only three of the water stations.

The present pressure for power emphasizes the effect of forcing boilers. This is shown specially in flue and firebox mileage, and on one road visited by our representative it was found that freight engines and passenger engines also required more roundhouse work than ever before. This has led to experiments in improving circulation by reducing the number of flues and increasing the spaces between them. An effort is being made on that road to ascertain whether the loss in heating surface will not be more than made up in the improved circulation. In this case 1-in. spaces between the flues are provided. Mr. Van Alstine directed attention to this in his article upon rational boiler design in the June number of the current volume of this journal. Others are becoming interested in this subject, and there seems to be a tendency toward reducing heating surface somewhat in bad-water districts for the sake of reducing boiler repairs.

Remarkable feeds and speeds of lathe work at large manufacturing establishments have been frequently recorded of late. They are beginning to be found also in railroad shops. In one place our representative found a coach-wheel lathe turning the tires of 33-in. wheels at the rate of six pairs per day. The roughing cut was ⅜ in. deep and ⅛ in. feed, the chips coming off a brilliant purple color with no water. This was done on a Niles lathe that had seen hard service for nine

years. The tool steel was a new brand and the job was done on piece-work.

In another shop a new high-grade tool steel was recently tried on a 58-in. Latrobe tire 5½ in. wide. The machine was a new 84-in. Niles lathe, and the tool finished the tire without grinding, the cut being ½ in. deep and the feed 1-16 in. at a speed of 31 ft. 4 ins. per minute. With ordinary tool steel a 56-in. tire was turned at 11 ft. per minute, the cut being ½ in. deep and the feed 1-32 in. This tool required grinding after cutting a distance of 2 ins. across the tire. At this point the tool of special steel was again put in at ½-in. cut and ⅛-in. feed. It ran at a speed of 31 ft. 4 ins. per minute and soon stalled the lathe. The lathe was in a group driven by a 25 h.p. motor, and when the other machines were cut out the motor, a Crocker-Wheeler, supposed to be capable of sustaining an over-load of 100 per cent., was again stalled. This lathe is to be equipped, as it ought to have been originally, with a 35 h. p. direct-connected motor.

In the same shop a test was made with the same steel in a boring mill. The tire was bored at a speed of 27 ft. per minute, the cut being ¼ in. and the feed 3-32 in. A tool of ordinary self-hardening steel took a 5-16-in. cut with a 1-32-in. feed at a speed of 12 ft. per minute, the tool giving out after cutting 1¼ ins. through the tire. Six and seven hours were required for boring a pair of tires with ordinary steel as against four hours for a pair of the same size with the special tool steel. Less time would be required with the new steel if the machine was rigid enough to stand up to the work.

In still another shop the line shafting has been speeded up 21 per cent. since last year. Planers for general work are driven at 28 ft. per minute, the shafting for the group-driven machines running at 170 revolutions per minute. In this shop 33-in. coach wheels are turned in an old lathe at the rate of three pairs per day. When ⅜ in. of material is to come off the first cut is ¼ in. and ¼ in. feed at 35 ft. per minute and the finishing cut is ⅛ in. with ¼ in. feed and the speed 40 ft. per minute.

On the boring mill the time for boring out a 79-in. tire was stated to be one hour, the cut and feed being ⅛ in. and the speed 57 ft. per minute. This time is said to include that for setting the tire in the machine.

In the wheel lathe tires are turned at 35 ft. per minute with ¼ in. cut and ¼ in. feed.

In another shop a record of 50 lbs. of steel per tire per hour was reported for a wheel lathe and one of the new brands of tool steel.

These records were taken from verbal statements. They represent wide differences in practice, but they serve to reflect increased attention to the commercial aspect of railroad shop practice, and they indicate the advantages of motor driving.

Speaking of piece-work brings up an interesting fact concerning machine tools. There is nothing like it to bring out the deficiencies in tools and tool steel. Piece-work generally means heavy cuts and fast feeds. A man running a fine new lathe was asked how he liked it. He replied: "It would do very well a few years back, but it's not a piece-work tool." His answer was confirmed by the chattering of the lathe. This is one of the best reflections of the effect of piece-work. It is also a hint to the tool builders. They will have a brisk race to keep up with the rapid advances now being made in tool steel. New, high-grade tool steel was found in a number of railroad shops visited. It should be found in all of them. The era of heavier machines, heavy cuts and rapid feeds has really begun on railroads. This is very noticeable.

In discussing machine-tool progress, a well-known motive power official said: "We are really past the stage of shop practice which permits of leaving the shop problems in the hands of a general foreman reporting to a master mechanic who must of necessity be away looking after road work half of his time. We must have shop superintendents with full authority who are qualified to hold equivalent positions in commercial establishments. To secure such men higher salaries must be paid. The time has passed for the $1,500-a-year general foreman to have the responsibility of repairs to 500 locomotives per year and the building of new engines. A commercial superintendent can save his salary over and over in the cost of the work, and it is absurd to pay the foreman less than only fair workmen receive in contract shops. We now have men who are worth $1,500 a year, but we need $3,000 men, and we must have them to get the engines out."

Every new shop has electric power, and the variety of opinions expressed in the distribution plans is noteworthy. This applies not alone to the electric systems themselves, but to the methods of attachment of motors to tools. Motive power men complain that they can get very little help from either the machine-tool builders or the electrical people. The tool builders give but little assistance with regard to the ranges of speeds which must be provided. In one case constant speed motors, cone drives and short belts from the motors to counter-shafts were recommended, thus throwing away a large portion of the advantage of motor driving as to ranges of speeds. On the other hand, the electrical people, in this case, recommended ranges so wide as to involve unreasonable expenditure in installation. The railroad officer had to decide for himself, and he was fortunately well able to do so. This is not as it should be. Motor driving of tools is yet in its infancy, but it is time to put practice in better shape. An electric driving installation is expensive, and inasmuch as its chief advantage is in the convenience of operation, some substantial progress should begin immediately.

Increased efforts to better provide for cleaning and repairing air brakes are noticeable, but on many roads little attention is given them. A large road, having 35,000 cars, employs 14 men to systematically and completely repair the brakes of 900 cars per week. The triples and brake cylinders are cleaned, the train pipes and hose overhauled, new gaskets put in and a test made. At this rate the entire equipment will be overhauled in less time than a year if it all gets to the shops. This work is necessary, as leaky train pipes are becoming a serious menace, as well as a source of expense and annoyance. Cases of the application of brakes by leakage are known to exist. The locomotive men are up in arms because of the demands for larger air pumps. Where trains are long it is not unusual to find two pumps on an engine, and two large ones are actually needed.

It seems strange that the old discarded "straight-air" brake should again be taken up and vigorously recommended, but this is done. It is being introduced in a new way, however, and for a new purpose. It is applied to locomotives and tenders of passenger, freight and switch engines, the number of roads where it was found being so large as to indicate the probability of a general introduction of the practice. "Straight air" is applied to the engine and tender in a way which does not at all interfere with the automatic brake. The "straight air" enables the engineer to apply and release the locomotive brakes as gradually as he pleases, and by its use he can "bunch" the cars together before applying the train brake and he can hold the slack of the train when releasing the automatic brakes in a long train. At low speeds it is dangerous to release the automatic brake without "bunching" the train from the engine. It insures the fullest braking power on the driving wheels. At water-tank stops its value in passenger service is noteworthy, and on mountain grades it is an important safeguard as a good and efficient retainer while the train reservoirs are being recharged. Used on switch engines, it stops the use of the reverse lever for making quick stops. Those who are using "straight air" speak enthusiastically of it as the greatest recent improvement in the air brake. It is being introduced pretty generally through the West.

(To be continued)

TWO NEW VANDERBILT CARS.

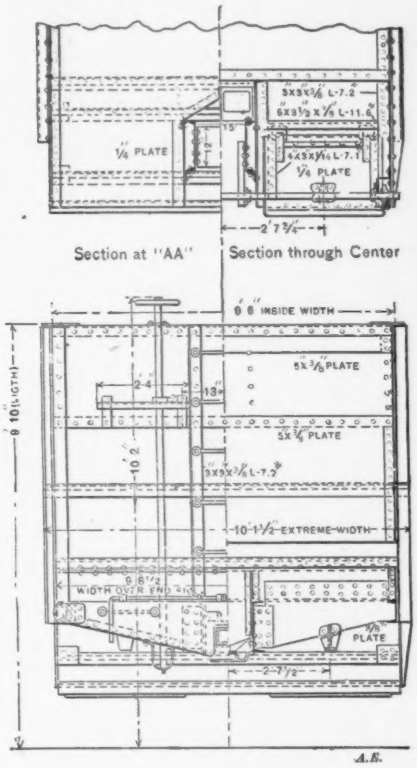
80,000 Pounds, Hopper Type.

Two new designs for structural steel cars of 80,000 lbs. capacity have been completed by Mr. Cornelius Vanderbilt. One is for limestone and the other for coal, the essentials being the same in both and the differences being in the detail construction. Both are of commercial shapes and plates and both employ Mr. Vanderbilt's patented method of construction.

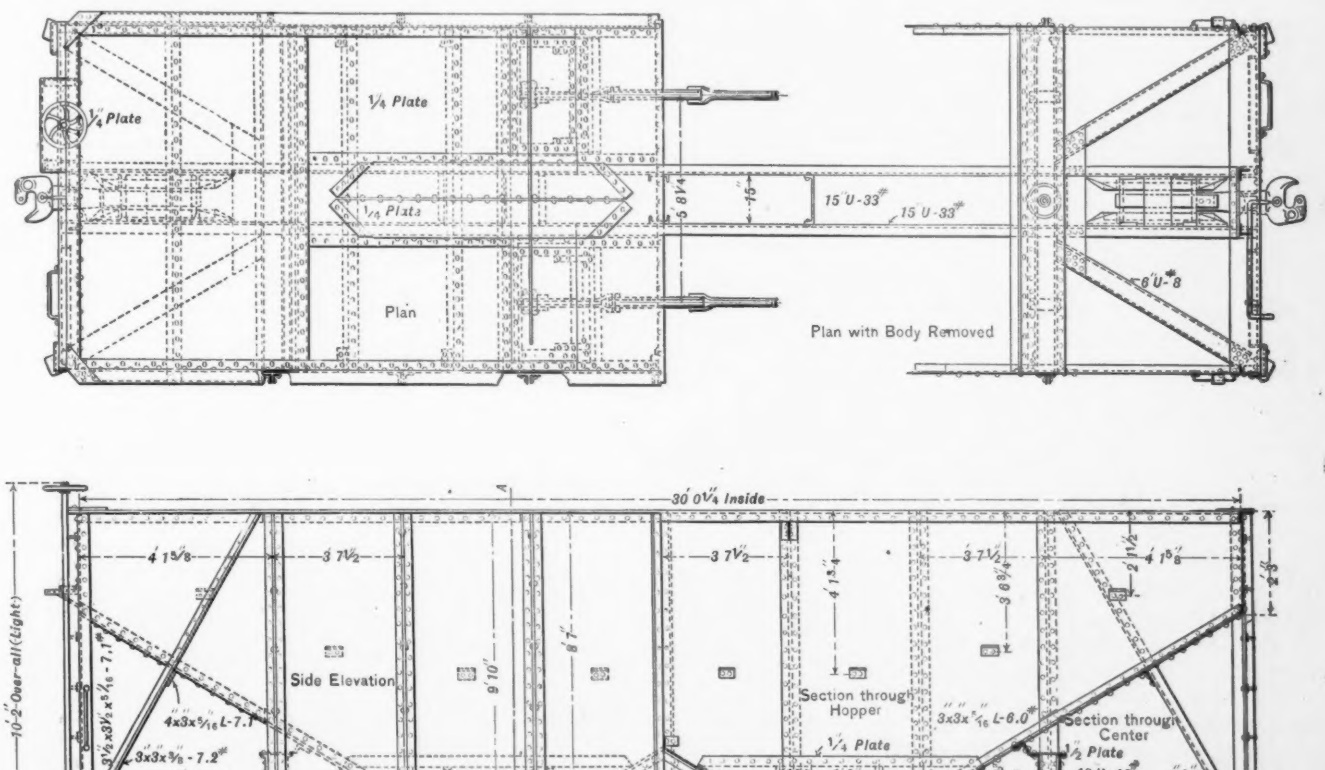
The coal car has the following dimensions:

Length inside car	30 ft. ¼ in.
Length over end sill	31 ft. 6 ins.
Length over couplers	34 ft.
Truck centers	21 ft. 9 ins.
Width inside car	9 ft. 6 ins.
Width over body	10 ft. 1½ ins.
Width over end sill	9 ft. 6½ ins.
Height, top of rail to top of brake-shaft	10 ft. 2 ins.
Height, top of rail to top of sides	9 ft. 10 ins.
Height, top of rail to bottom of hopper	1 ft. 3 ins.
Height, top of rail to center of coupler	2 ft. 10½ ins.
Height, top of rail to top of end sill	3 ft. 8 11-16 ins.
Height of sides	8 ft. 7 ins.
Capacity, level full, 1,569 cu. ft.	81,600 lbs.
Capacity, heaped 30 per cent., 1,864 cu. ft.	97,000 lbs.

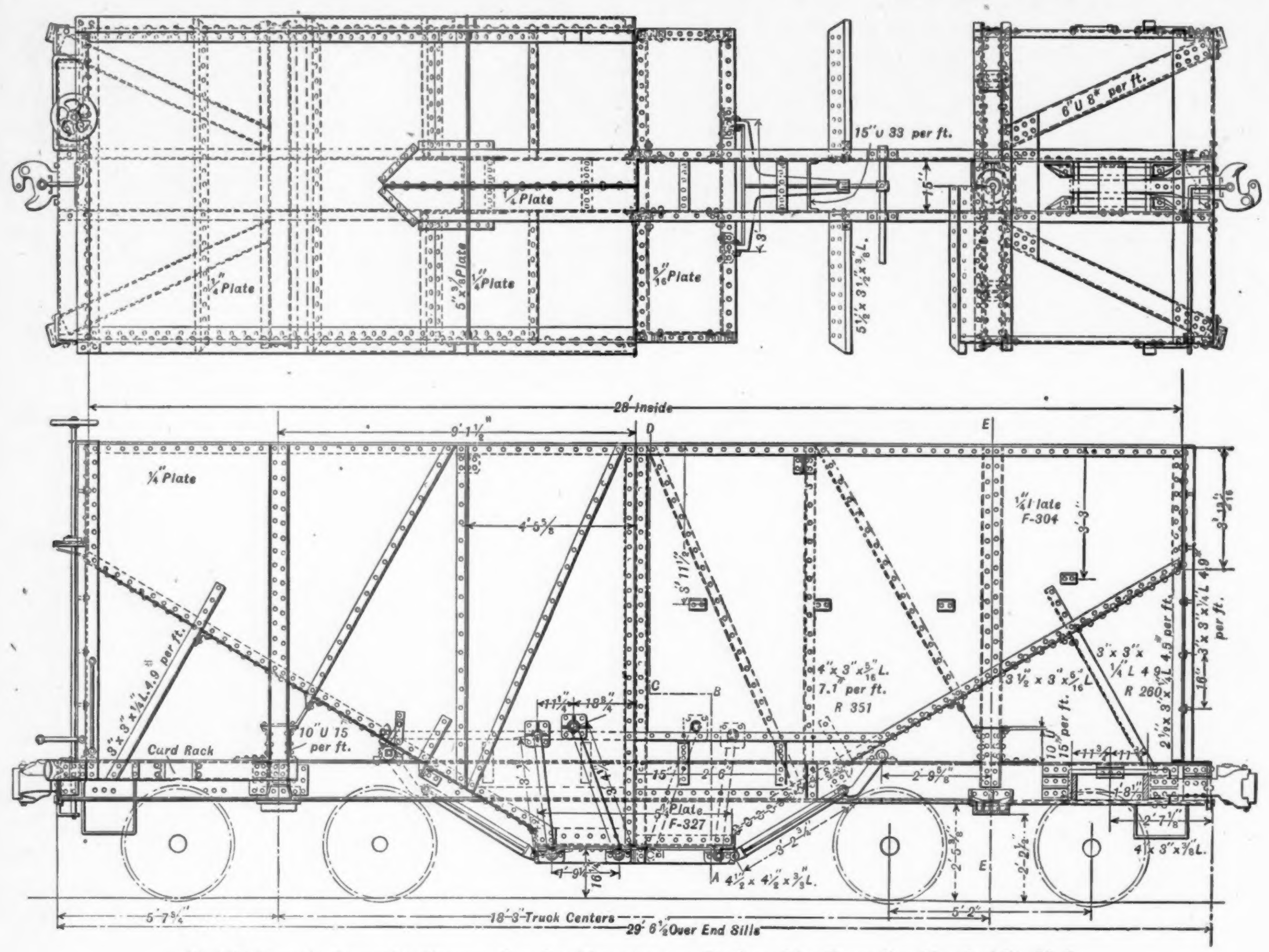
The coal car has the usual form of hopper doors with the door-operating mechanism between them, but the side plates extend down to the level of the lower angles of the hoppers, where they are cut parallel with the rail at a distance of 15 ins. from the rail. This construction gives a very deep side in the form of a plate girder. There are no side sills extending the full length of the car, but this car has short side sills at the ends, extending from the corner posts to the sloping floor plates, terminating at the ends of the first panels inside of the body bolsters. These are of 6-in. channels with the flanges facing toward the center sills. The side plates come down over them at the body bolsters. This construction



Transverse Section and End View.



80,000 Pounds Capacity Hopper Coal Car.—Designed by Cornelius Vanderbilt, M. E.

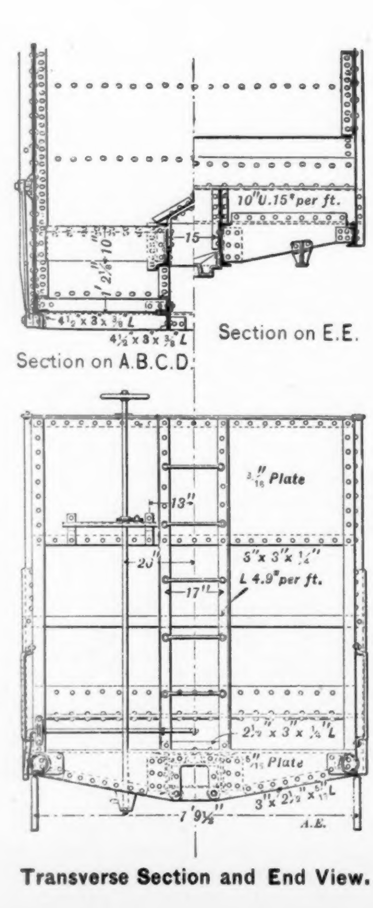


80,000 Pounds Capacity Hopper Car for Limestone.—Designed by Cornelius Vanderbilt, M. E.

is very much stronger in its support of the corner posts against push pole or cornering stresses than either of the earlier Vanderbilt hopper cars which were illustrated in this journal in November, 1901, page 338, and April, 1902, page 102.

The hopper form of cars is favorable to a good body bolster construction. These bolsters are 10-in. channels resting on top of the 15-in. center sills and covered by ½-in. cover plates, which are extended and bent to form floor supports for the hoppers. The bolsters are further stiffened and connected to the center sills by large ⅜-in. bracket plates, which are also secured to the short side sills by angles and to the inside faces of the bolster channels by rivets.

In this car the brace angles for the side plates are all vertical except at the end panels. As in the earlier designs, the panel spacing brings vertical members at the ends of the bolsters to serve to transmit the load of the plate girders directly to the bolsters. The omission of the diagonal braces of the side plates does not sacrifice strength, and it lessens the expense of construction, and also the weight. In this design the floor plates are not flanged, as in the earlier construction, to rivet them to the side shannels. In this case the channels are replaced by angles.

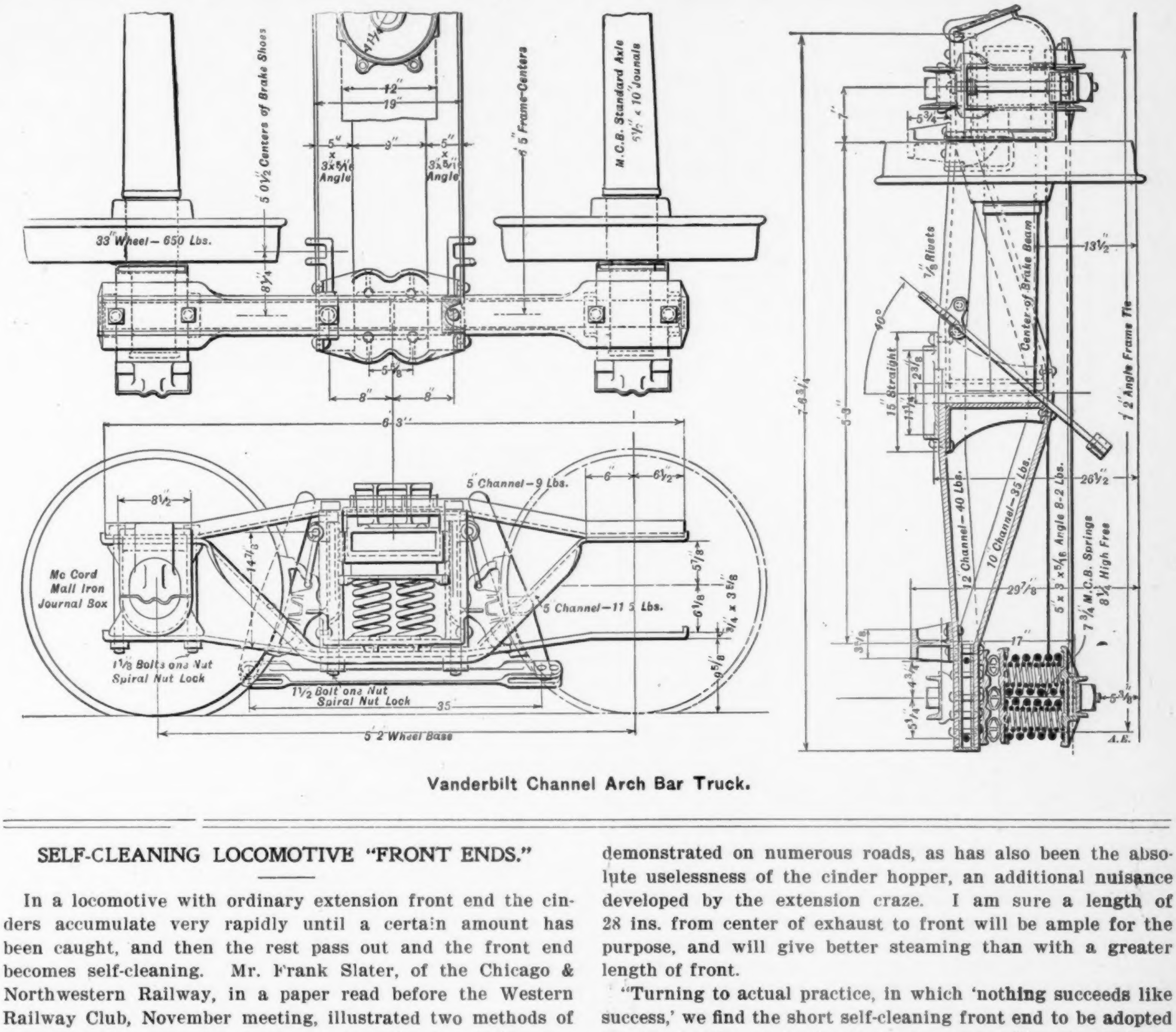


Transverse Section and End View.

The limestone car differs from the coal car in the center sills, which are 12-in. channels. It differs also in the length of the short side sills, which extend only to the bolsters, in the bracing of the sides and the absence of the wedge-shaped construction of the floor at the center of the car. In this design the load comes directly upon horizontal doors at the bottom of the single large hopper, and these doors swing bodily on link hangers. They are not hinged.

The body bolster construction is similar to the other Vanderbilt hopper cars and the vertical side-stiffening members at the bolsters are in this case 6-in. channels secured to the ends of the bolsters and transmitting the load from the side plate girders to the bolsters. The depth of the sides at the center of this car is 10 ft., and the bottom of the side plates comes down to a distance of 16¼ ins. from the rail.

These cars are designed to use the truck recently patented by Mr. Vanderbilt, which is used under 800 hopper cars built by him for the West Virginia Central, already referred to. The principal feature of this truck is the flattening of the flanges of the arch bar channels over the journal boxes. The engravings show a built-up truck bolster, but the latest design employs a cast steel bolster of the same general form. The top arch bar is a 5-in. 9-lb. channel, and the tension member is an 11½-lb. channel. The steel end casting combines the spring seat, brake-hanger fulcrums and arch-bar columns in a **single casting.**



Vanderbilt Channel Arch Bar Truck.

SELF-CLEANING LOCOMOTIVE "FRONT ENDS."

In a locomotive with ordinary extension front end the cinders accumulate very rapidly until a certain amount has been caught, and then the rest pass out and the front end becomes self-cleaning. Mr. Frank Slater, of the Chicago & Northwestern Railway, in a paper read before the Western Railway Club, November meeting, illustrated two methods of arranging the extension front end to make it self-cleaning. He strongly recommended such practice.

In the discussion Mr. J. Snowden Bell made some plain and forcible statements with reference to the long smokebox which should be carefully considered. He said, in part:

"The absolute fallacy of the 'spark-retaining' theory, upon which the claims of advantage of the extension front are chiefly based, has been so long ago and so fully demonstrated in railroad service that it is difficult to understand how anything other than prejudice or mere force of habit keeps the extension front out of the scrap-pile. It is too obvious to need argument that after an engine having a supposed 'spark-retaining' extension front has run a few miles and banked up a small quantity of cinders at the front of the extension, the cinders are thrown out during the remainder of the run, and, as stated by Mr. Slater, 'over a greater portion of the division the engine is being operated with what might be termed a self-cleaning front end' and the engine 'soon converts itself into a self-cleaner.'

"To sacrifice the positive advantages of freer steaming and reduction of back pressure due to the employment of a larger nozzle, which are attainable with a short front, for the doubtful one of transporting a small quantity of cinders to a terminal in an extension front, does not appear to be either good policy or good practice. That all the area of netting which is necessary can be located in a short front has been conclusively demonstrated on numerous roads, as has also been the absolute uselessness of the cinder hopper, an additional nuisance developed by the extension craze. I am sure a length of 28 ins. from center of exhaust to front will be ample for the purpose, and will give better steaming than with a greater length of front.

"Turning to actual practice, in which 'nothing succeeds like success,' we find the short self-cleaning front end to be adopted in what I believe to be the best and most intelligently designed locomotives in existence, viz., Mr. Marshall's 2—6—2 type of heavy fast passenger engines on the Lake Shore road. In these engines the distance from center of exhaust to front is only 30 ins., and in the latest design of six-wheel shifters, with wide firebox, on that road, this distance is 28 ins. No cinder-hopper is used or needed on either of these types, and the exhaust nozzles of the 2—6—2 engines are, I believe, 5¾ ins. Their steaming qualities are admittedly of the best, and if any engines with 'spark-retaining' extension fronts equal them in this regard, or surpass them as to cleanliness and freedom from fire-throwing, the evidence to that effect has yet to be produced."

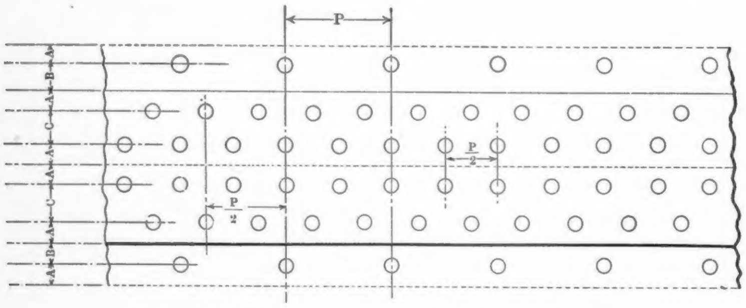
The Pittsburgh Spring and Steel Company have purchased the Fifty-third street plant of the Pressed Steel Car Company in Pittsburgh, consisting of five acres of land with suitable buildings, and will be prepared to execute orders January 1, 1903. The plant will be equipped with the best of facilities and equipment and will have a greater capacity than the works of the A. French Spring Company. In addition this new company expects to equip for the rolling of their own steel. The capital is $500,000. Mr. D. C. Noble, formerly secretary and treasurer of the A. French Spring Company, is president.

TABLE OF SEXTUPLE RIVETED SEAMS.

For Locomotive Boilers.

The accompanying diagram and table, in use in the drawing room of the mechanical engineer's department of the Lehigh Valley Railroad, will be found very convenient in laying out locomotive boilers. It saves a large amount of figuring, which is usually resorted to in order to obtain the right pitch of rivets in these seams.

The primary object was to get absolutely tight seams. In the thicker plates the efficiency of the seams has to a degree been made subservient to tightness and the saving of weight has been carried as far as is consistent with good practice. The form in which this information is put speaks for itself,



Prefer that Original Diameter of Hole allow for 1/32 inch Reaming.

Plate	Rivet	A	B	C	D	E	Max. P	Pitch Eff. %	Min. P	Pitch Eff %
½″	⅞″	1¼″	1⅜″	2⅛″	7/16	½	7	85.01	6½″	85.11
9/16	1″	1⅜″	1⅜″	2⅜″	7/16	½	7¼″	84.00	6¾″	83.36
⅝	1⅛″	1⅛″	1⅜″	2⅞″	½″	9/16	7½″	82.99	7″	82.56
11/16	1⅛″	1⅛″	1⅜″	2⅞″	9/16	⅝″	7½″	82.35	7¼″	81.72
¾″	1¼″	1⅜″	1⅜″	3″	⅝″	11/16	7½″	81.78	7¼″	82.38
13/16	1¼″	1⅜″	1⅜″	3″	11/16	¾″	8″	81.55	7¾″	80.28
⅞″	1¼″	1⅜″	1⅜″	3″	¾	13/16	8″	80.00	7⅞″	79.59

A. E.

Holes 1/16 inch Larger than Diameter of Rivet

Table for Sextuple Riveted Seams for Locomotive Boilers.

and it will be invaluable to the draftsman in making boiler drawings. Mr. Gaines, of the Lehigh Valley, informs us that this diagram was devised by Mr. W. H. Mussey when he was connected with the drawing room of that road.

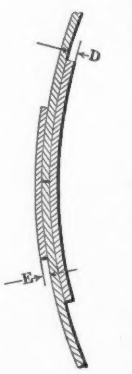
AN IDEAL VARIABLE-SPEED ELECTRIC MOTOR.

An unlooked-for development of the problem of electric drives for machine tools was announced in a recent lecture before the Central Railway Club at Buffalo, delivered by Mr. L. R. Pomeroy, special representative of the railroad department of the General Electric Co. In his remarks relating to variable speed motors he advocated for the direct current type, motors having provision for speed variation by changes in field strength, by means of variable resistances in the field circuit, as being the most satisfactory. This method of speed control has long been judged impracticable on account of the very serious sparking at the brushes, but it was announced that a special motor has been developed by the General Electric Co., which avoids this difficulty by means of its small armature reaction. On account of the constant potential across its armature at all times it will maintain a constant speed under changes of load and thus avoid the great objection to motors using the rheostatic control. This method of field control is economical on account of the fact that the total current used in the field coils of a motor is not more than 5 per cent. of the armature current at full load so varying it can have but little effect on the total current. This method also permits a wide range of speeds with a large number of steps and the size of controller required is much smaller. A 10 h. p. motor of this type, running on a 250-volt 2-wire system, has a range of speed of from 350 to 700 r. p. m.

In view of the great importance of the development of this form of motor speed control—so long given up as impracticable —as well as also the admirable treatment of the subject of electric drives in Mr. Pomeroy's paper, further consideration will be given to his paper in our next issue.

PERSONALS.

Mr. G. W. Crownover has been promoted from the position of general foreman of the Illinois Central at Waterloo, Iowa, to that of master mechanic at Freeport, Ill. He succeeds the late E. O. Dana.



Mr. B. F. Flory has been appointed mechanical engineer of the Lehigh Valley Railroad to succeed Mr. F. F. Gaines, recently promoted to the position of master mechanic of the Wyoming division.

Mr. J. J. Reid has resigned as assistant superintendent of motive power of the Rutland Railroad to accept the position of general machinery and locomotive inspector of the Northern Pacific, with headquarters at St. Paul.

Mr. W. L. Harrison has resigned the position of superintendent of shops of the Central Railroad of New Jersey to accept that of master mechanic of the Choctaw, Oklahoma & Gulf Railroad, with headquarters at Little Rock, Ark.

Mr. F. F. Gaines, formerly mechanical engineer of the Lehigh Valley Railroad, has been appointed to the position of master mechanic of that road at Wilkesbarre, Pa., vice Mr. E. T. James, who has been transferred to Buffalo in place of Mr. G. W. Seidel, resigned. Mr. Gaines has held the position of mechanical engineer since April, 1897, and has done excellent work in the motive-power department of the road and in connection with important committees of the Master Mechanics' Association. He was educated at Cornell University.

P. S. Blodgett, general manager of the Lake Shore & Michigan Southern, died October 27 at his home in Cleveland, at the age of 59 years. He was a native of New Hampshire and began his railroad service as a clerk on this road at Adrian, Mich., and never had any other employer until he was called to New York in June of last year as general superintendent. Last February he returned to the Lake Shore as general manager. Mr. Blodgett was a remarkable man, quiet in manner, and had an energy and force which did much to put the Lake Shore into its present high position. His subordinates did their best to assist him because they loved him. They could not help doing so, because of his personality. Had he been less modest and retiring in disposition, he would have been more prominent before the public, for his natural ability and sagacity were unusual. But his life was, for a railroad officer, a quiet one with reference to the public. It was a privilege to meet him and an honor to know him. The influence of his character and his methods will long remain as a priceless tradition of the Lake Shore road.

THE COMPOUND LOCOMOTIVE AND ITS DEVELOPMENT IN FRANCE.

BY A. HERDNER.

Assistant Chief Engineer of Motive Power and Rolling Stock. Southern (Midi) Railways of France.

Editor's Note.—The translation of this paper is by Mr. Charles M. Muchnic, Mechanical Engineer of the Denver & Rio Grande Railway.

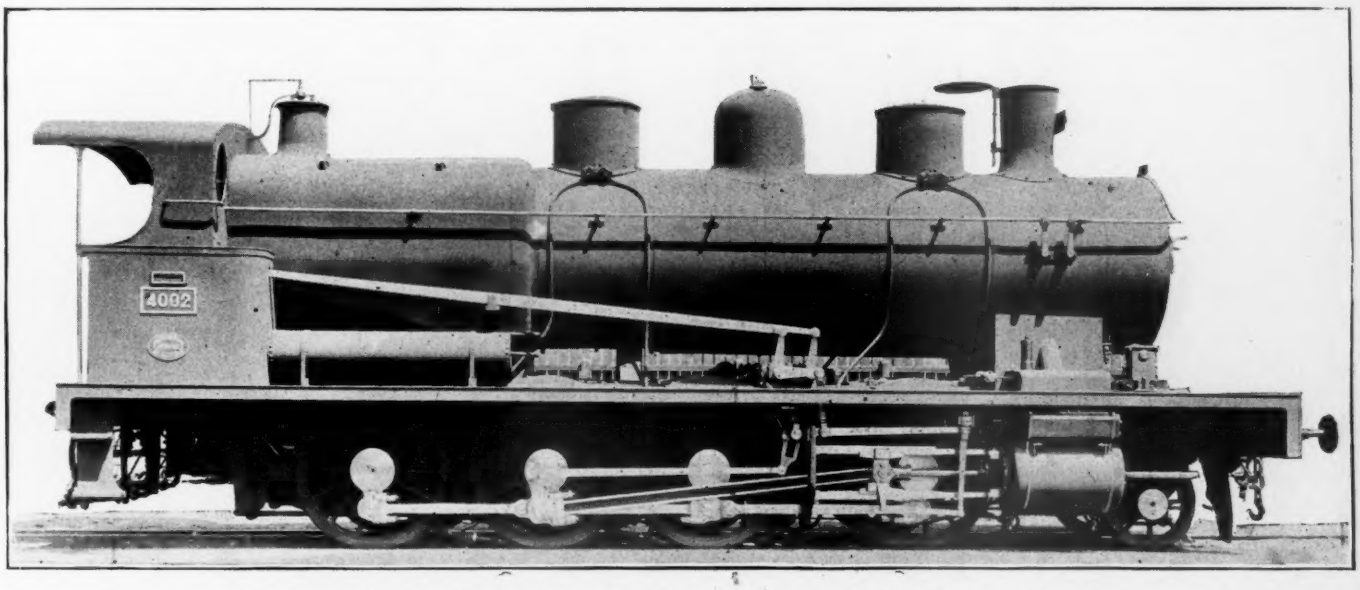
The compound locomotive may be considered, from several points of view, as a French production. It was, indeed, for a French railroad that the first locomotive of this type was built at Creusot (Schneider & Company, Creusot, France) in 1876, after the designs prepared by Mr. Mallet. The principle even upon which the superior economy of multiple expansion is based—that is to say, the absence of adiabatic losses in the cylinder walls—was proclaimed and demonstrated experimentally by two French scientists, Reech and Hirn. Finally, the compound locomotives that are in actual service to-day on French railroads are justly considered among the most perfected. It is not, however, to be inferred that the compound locomotive has made its entire evolution in France and has gone through all the stages of its development there. Like many another inventor, or initiator, Mr. Mallet was not a prophet in his native land. His example was first followed in foreign countries, especially in Russia, by Messrs. Borodine and Urquhart, then in England by Messrs. Webb and Worsdell. But it was in Germany, thanks to the persevering efforts of Mr. Von Borries, that the use of double expansion has been developed most rapidly, and it can be said that the Hanover division of the Prussian state railways became, beginning with the year 1880, one of the principal scenes of the contest that then ensued between the old and the modern systems of steam expansion—a struggle from which the compound locomotive came out triumphantly, as is acknowledged to-day.

At first the compound made little progress, but later it was used more and more. At the end of the year 1890, ten years after the trial by Mr. Von Borries, Germany possessed not less than 430 compound locomotives. At the same time the seven trunk lines of France had only 32, of which 23 were tandem eight-wheel connected compounds of the Woolff system, belonging to the Northern Railways of France. The other 9 were experimental locomotives which were never reproduced except in one or two cases.

It was not until 1892, after the success of the two high speed locomotives, Nos. 2121 and 2122 of the Northern Railways of France, the latter of which figured at the World's Fair in Chicago, as well as the locomotives C-11 and C-12 of the Paris, Lyons and Mediterranean Railways, that the ideas and tendencies toward double expansion have been definitely settled and that the French railway companies have entered resolutely the field so brilliantly opened by two of them.

On the first of January, 1902, ten years after the Northern Railway locomotives Nos. 2121 and 2122 were put into service, the number of compound locomotives in actual service on the seven principal railroads of France were 1,128 and of the following types:—

Two locomotives, having two main driving axles not coupled, one engine having four cylinders, the other three cylinders; 405 locomotives having two main driving axles coupled and four cylinders; 540 locomotives having three coupled axles, of which sixteen are two-cylinder compound; 1 three-cylinder and the remainder four-cylinder compounds; 18. locomotives having four coupled axles, of which twenty-three are tandem compounds and the remainder four cylinder divided compounds.



Eight Coupled 4-Cylinder Compound Freight Locomotive.—Southern Railway of France.

Detail drawings of this engine will appear in a later number.

While Germany created none but two-cylinder compounds, and Mr. Webb remained true to his three-cylinder type, France, on the contrary, has adopted rather promptly the principle of compounding four cylinders, whose application has since become general, and which has enabled French railways to increase the speed and load of trains,—especially of express trains—to a point till then unknown. Indeed, of the 32 compound locomotives that the seven principal railroads possessed at the end of the year 1890, 29 were of the four-cylinder type, two others had three cylinders, one of the Webb system having a single low-pressure cylinder, and the other of the Sauvage system, having a single high-pressure cylinder. As to the two-cylinder compound type, then so flourishing in Germany, and which type otherwise continued to give satisfaction on the small railroad from Bayonne to Biarritz, it was represented in France, on suburban or secondary railroads, by but one engine. It was a locomotive of the French State Railways, having six coupled wheels, transformed into compound in 1888, and which was, moreover, again rebuilt to its original construction a few years later. Two other two-

cylinder compound locomotives, built in 1892 for experimental purposes by the Eastern Railways of France, did not seem to have more success, and only in 1900 do we see a French railway, the Southern, after very encouraging tests, apply the two-compound cylinders to a lot of fourteen locomotives.

It would perhaps be difficult to evince the motives, apparently complex, for which this type of compound has been so unfavorably received in France. The epithet "limping" which occasionally is disdainfully applied to this type, seems to indicate that the reproach applies above all to the dissymmetric, or, in other words, to the inequality of work and forces developed on the two sides of this type of locomotive. The equality of work is beyond doubt desirable, and it is quite evident that it can very nearly be realized for a certain position of the reverse lever and for a certain speed, but it cannot have the same degree of equality for a different admission with a different speed, and especially so when the valve motions of both cylinders are interdependent, which is the general practice. Nevertheless it seems that the probable inconveniences caused by the lack of symmetry have been singularly exaggerated; the importance of these inconveniences is quite limited, since no locomotive, even of simple expansion, is rigorously exempt from them. In fact, a difference from the equality of work on either side of the engine of 20 per cent., and even of 25 per cent., for the most various positions of the reverse lever and speed, and which difference can be reduced to 5 per cent. or 10 per cent. when in the ordinary working gear and speed, cannot produce in practice any detrimental consequences.

Regarding the starting of the two-cylinder compound from a state of rest, which is one of the serious inefficiencies of this type of compound, it seems that the Mallet locomotive has been more severely dealt with than the old simple expansion locomotive. When these latter engines, for certain positions of the cranks, refuse to move the train without first "backing up," no one finds fault with it; this has, so to say, become a matter of course. But when a two-cylinder compound must "back up" to get slack in order to start a heavy train from a state of rest, many a person is still disposed to see in that an inherent defect of this compound system. It is true that the two-cylinder compound necessitates the use of a special apparatus—the intercepting valve—in order to start from a state of rest, and which is unnecessary in the simple engine. But it is also true that, thanks to the intercepting or starting valve, the compound picks up a train fully as well, and often better, than the simple engine. Although Mr. Mallet has given a very complete solution to this problem at the very beginning, there is indeed no apparatus that exercised more the ingenuity of the inventors than the intercepting or starting valve, and from the numerous designs proposed it is not difficult to find one of a very simple construction that will enable the compound locomotive to start more smartly than the similar simple engine, irrespective of the position of the cranks of the former. Such, indeed, is the case of the starting valve I have applied to the locomotives built by the Southern railways and which apparatus consist simply of a small valve, by the operation of which the engineer is enabled to admit live steam into the low pressure cylinder through an opening made in the middle of the cylinder wall and of about 2 sq. ins. area; the displacement of the same valve admits live steam through an opening of about 1.66 sq. ins. into the receiver.

More serious are the criticisms made in regard to the large dimensions requisite for the low pressure cylinder. It is true that the designer is often confronted with the difficulty of locating it, of giving ample section for admission and exhaust passages, and finally to counterbalance properly the excess weight of the low pressure piston. Also the two-cylinder compound arrangement is not the solution that suits best the powerful locomotives demanded to-day for the movement of trains on railroads having a heavy traffic. But it is essential to remark that all of the above objections disappear when it concerns the design of compound locomotives of moderate tractive power; that is, of locomotives that do not demand an evaporation of more than 11,000 to 13,200 lbs. of steam per hour, and which can therefore be made within the normal proportions of locomotive boiler construction in France, with a grate area not exceeding about 22 sq. ft.

There is then a class of locomotives, and quite an important one, for which the compounding of two cylinders constitute not only a very plausible solution, but one which is yet the simplest and the most advantageous. We must neither forget that of all compound locomotives it is the two-cylinder compound that offers the least surface for steam condensation, that it is still the two-cylinder compound that yields the best performance in effective work, and finally it is on the two-cylinder compound that the repairs are the least difficult, because, all things being equal, the dismantling of its parts is much easier. I will say further, the absence of the two-cylinder compound in the motive power equipment of the different French railways represents even to-day, in my estimation, a void to be regretted.

The custom is indeed not to create any new types of locomotives for the main lines until the traffic, having become more intense, justifies the employment of more powerful machines. The secondary or branch lines are very seldom operated by locomotives specially built for that service; most often they make use of the locomotives that have become insufficient for the roads of the first order. It is therefore beyond doubt that had the French railway companies adopted the two-cylinder compound, as has been done in foreign countries, all the locomotives built during the period of 1880 to 1890 and even to 1892 after rather old designs, the motive power of the secondary line would have been to-day, if not absolutely modern, at least far more economical than the motive power they are using to-day, and will naturally have to use yet for some years to come.

Certain railway companies have thought it not yet too late to remedy this deficiency, and it was for this reason that the Southern Railway was led to transform into two-cylinder compounds fourteen locomotives of the Mogul type, of which mention was made above. Other locomotives are being redesigned with a view of applying the two-compound cylinders as soon as those engines get back to the shop for general repairs; for a certain number of old engines this transformation will be quite advantageous. Finally, if we are correctly informed, other roads are doing work in the same direction.

The two-cylinder compound having thus been re-established and the value that it has apparently acquired in the present railroad operation having thus been defined, it is evident, as we have already remarked, that the more and more powerful locomotives that are being put into service on lines of intense traffic cannot be compounded according to the same formula, but four cylinders are absolutely indispensable.

While all two-cylinder compounds belong to the same type, differing from each other only in the design of the intercepting valve—i. e., of an organ of relatively secondary importance—the four-cylinder compounds can be of very different types. These different types may be classified according to their most essential parts and construction into three principal classes, which are characterized as follows:

1st. Having two main crack pins and two valve motions.

2nd. Having four main crank pins and two valve motions.

3rd. Having four main crank pins and four valve motions.

The first comprises the locomotive type well known as the "Vauclain," the type with concentric cylinders and also those of the tandem compound types.

The second class comprises the six-wheel coupled engine recently built by the Baldwin Locomotive Works for the Plant System of Railways as well as the design of the "Atlantic" type engine prepared by Mr. Muchnic for the Wisconsin Central Railway, drawings of which the author has kindly sent to me. (See American Engineer and Railroad Journal, January, 1902, page 24.) To the same class belong the three

locomotives exhibited at the Paris Exposition (Parc de Vincennes) in 1900, by Mr. Webb, by Mr. Von Borries and by the Meridional Railway of Italy. This last locomotive, however, presents that important particularity in contradistinction to the types above cited, that both high pressure cylinders have one common valve and both low pressure cylinders have one common valve.

Finally the third class comprises the different types of locomotives that are in service on most of the French railroads and were created by Mr. de Glenn or constructed on the same principles, the express locomotive built by the Chemnitz works for the state roads of Saxony and exhibited in 1900 at the Paris Exposition; the locomotive types designed by the Paris, Lyons and Mediterranean Railways; the locomotives of the Saint Gothard Railway, the one of Central Switzerland and finally the swivel truck locomotives of Mr. Mallet. The de Glenn locomotives as well as the one of the state roads of Saxony are provided with two lifting shafts operated independently, on those of the Paris, Lyons and Mediterranean the two lifting shafts are interdependent and those of the Saint Gothard, of the Central of Switzerland and of Mr. Mallet are provided like all the locomotives of the first two classes with a single lifting

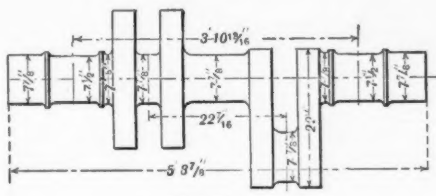


Fig. 1.

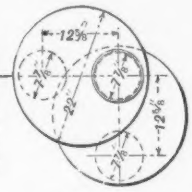


Fig. 2.

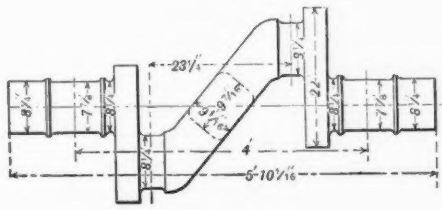


Fig. 3.

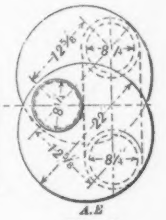


Fig. 4.

shaft. It will also be interesting to note that the four main cranks that characterize the third class of locomotives are on two different main driving axles, whereas on the locomotives of the second category, excepting the one of Mr. Muchnic, who equally employs two distinct main driving axles, the four cranks are always on one driving axle.

The locomotives of the first class present the advantage of lesser complications, and in this respect they approach very nearly the two-cylinder compound engine, but like the latter they are not adaptable for large increase in power. The power developed by the cylinders is being increased more and more, and so long as it is being persisted on to divide these forces on but two cranks it will be necessary to make use of engine transmission parts of much larger proportions, which are more difficult to handle. The masses subjected to a reciprocative motion can be counterbalanced in but a very imperfect manner, and the fatigue of the engine frames is being increased in direct proportion to the forces developed by the cylinders. It is, therefore, very essential to-day to consider future to make place for the locomotives with four main four-cylinder locomotives of the first class are for the above reason, in our estimation, destined to be abandoned in the future to make place for the locomotives with four main cranks which, by a better division of the total forces, permit of lighter engine parts, and in virtue of the possibility of setting the cranks at 180 degrees from each other permit of a much better equilibration of the reciprocating masses and exert a lesser strain not only on the engine frames but also to the permanent roadway on which they run.

It is true that excepting the Mallet type, whose arrangement responds to special conditions, the use of four cranks necessitates absolutely a crank axle—that is to say, a costly forging subject to cracks, and may, in case of failure, increase materially the cost of engine repairs.

The American locomotive builders have always shown themselves very little disposed to adopt the crank axle, and we can quite well understand their hesitation, having found ourselves in an analogous position but a few years ago. Indeed, until 1890 the Northern and Western Railways of France were the only roads that made use of inside connected cylinders for their high speed locomotives. The other roads have shown themselves more reserved. On the Southern particularly, to which the writer belongs, the crank axle was absolutely banished from locomotive construction, and when three years later, in consequence of the constant increase in weight of our express trains, we were led to put in service 14 four-cylinder compound locomotives similar to those of the Northern Railways of France, we were naturally very much concerned as to what service the crank axles, driven by the low pressure cylinder pistons, would render in practice. Those axles were of the Worsdell type with circular plates and are represented by Figs. 1 and 2.

The successive appearance of cracks on three of the axles after a mileage of 37,500, 58,000 and 133,000 miles respectively, seemed to justify the fears we had conceived in that respect, and yet a much longer experience leads us to-day to believe those fears to have been exaggerated. Of the fourteen crank axles put in service in 1894 and 1896 there remain eleven totally free of any fracture or crack, and their mileage varies from 212,100 to 293,900 miles.

In the more recent four and six-wheel connected locomotives the Worsdell axle has been replaced by the Z shape axle, as shown in Figs. 3 and 4. The design of this axle is obtained from the Worsdell axle by substituting in place of the two inner circular disks and the portion of the axle between by a rectangular bar connecting the two journals. Sixty-three of these axles have been put in service between the years 1896 and 1901, inclusive, and none of them have shown the slightest trace of a possible fracture, the oldest of these axles having already made a mileage of 206,200 to 242,000 miles. These results lead us to believe the axle of the Z shape is more advantageous than the one with the two circular plates, and indeed we give it preference to the former design, except when the central portion of the axle has got to be utilized for carrying the eccentrics, as is the case in our new consolidation type engine, about which I shall say a few words at the end of this article. At any rate, this manner of viewing this question will be still strengthened with longer experience.

One more remark we deem necessary to make on the subject of crank axles. When the cost of repairs and maintenance of locomotives is evaluated, it is the custom to proportion the same to the unit of the distance covered, without in any way considering the work performed; as the latter can vary from one to double for the different types of engines, and oftentimes in a ratio still greater, the comparison is necessarily unfavorable to modern locomotives, and so much more so as the power of the locomotives is increased. We do not doubt at all that if the same costs are proportioned to the units of the mechanical work performed—that is, the horse power—the comparison of these costs will generally bring out the advantage in favor of the more powerful locomotives, in spite of the crank axle that we were led to put in to obtain that very increase in power.

The four cranks thus combined can be arranged on one or two main driving axles. In the first instance the four cylinders are generally placed side by side in one transversal plane, while in the second case one pair of cylinders is placed most often to the rear of the other. It seems to us that the second arrangement affords a better distribution of the parts of the

engine, accentuates the effects due to the angularity of the main rods and causes a lesser strain to both the crank axle and the coupling rods. It also permits of a more direct path for the steam from the throttle valve to the exhaust.

We have noted above the essential advantage obtained by the use of four main crank pins with respect to the balancing of the reciprocating weights. It appears, however, that this advantage has never before been appreciated in France as much as it is to-day. This, no doubt, results from the fact that the power exacted from the early four-cylinder compound locomotives was relatively quite moderate. The Northern Railways of France has even renounced, for its first four-cylinder compound express locomotive, the very advantages obtained by doubling the number of cranks, since the two main driving axles were made entirely independent of each other. The rotative masses of each high and low pressure cylinder mechanism were then counterbalanced for each wheel separately, as though it concerned an engine of the "single driver type," and in accordance with the formula then used by the Northern Railways, one-third of the total weight of the reciprocating parts was added to the rotative masses balanced.

All the four-cylinder compound locomotives of the eight-wheel type for fast passenger service on the Northern Railways built after were counterbalanced in the above manner, although both driving axles were connected by coupling rods, which it was thought at the time were likely to be removed after the first trials; so that in principle at least the reciprocating parts were very nearly counterbalanced by each other on one hand, and on the other hand the excess of counterbalance carried in the wheels—that is, the additional one-third of the weight of the reciprocating parts—were balanced by each other also. In reality the high and low pressure cranks on each side were not keyed at an angle of 180; to facilitate the starting of the engine they were set at an angle of 162 degrees, and under these conditions careful calculations have led to the adoption of different counterbalance weights for the two wheels on one axle. To avoid such complications it has been decided to give each pair of wheels the same counterbalance weight equal to the arithmetical mean of the two weights calculated and their center lines arranged to coincide with the bisector of the angle formed by the direction of the two calculated counterbalance center lines of the two wheels.

The locomotives of the Nos. 1751 to 1784 series of the Southern Railways were more powerful and heavier than the first locomotives of the Northern Railways, were counterbalanced in the above manner, but it was found in actual service that at the maximum allowable speeds the stresses on the rail were excessive. It was then decided to take into consideration the partial auto-balance of the H. P. and L. P. reciprocating parts obtained by the relative position of the cranks at an angle of 162 degrees and not to enter into the calculations of the horizontal balance, but the resultant of the forces of inertia developed by the reciprocating weights and which are in opposite directions. As this resultant is very small it was possible to obtain a complete horizontal balance, but only in the line of motion of recoil and without considering the "transversal" disturbing forces. The same solution was applied to six-wheel coupled locomotives first adopted by the Southern Railways in 1896. In each case the excess counterbalance due to the reciprocating weights was divided equally in all wheels, which allowed us to reduce the periodic overloads on the rails to a minimum—that is, to reduce to a minimum what is commonly termed the "hammer blow."

When the Northern Railways of France, in 1897, adopted the same type of locomotive a similar method of counterbalancing was applied. However, according to old erroneous ideas, only one-third of the resultant of the inertia forces developed by the reciprocating weights of both H. P. and L. P. cylinders on one side was counterbalanced, but this resultant was balanced in the ordinary way—that is, by adding counterbalance weights directed at once against the longitudinal motion of recoil as well as against the transversal disturbing forces, and this additional weight was uniformly distributed in all wheels.

The Paris, Lyons and Mediterranean Railways, which also found it at first advantageous not to key the H. P. and L. P. cranks on its four-cylinder compound locomotives exactly opposite each other, and which have even made use of the relative positions of the cranks quite different from the 180-degree angle, have not thought necessary to balance wholly or even partially the reciprocating weights on its first six and eight-wheel coupled locomotives. Its compound locomotives for fast passenger service have never had more than a vertical balance.

At the present it appears that the advantages derived from the relative position of the four cranks, as originally adopted, and which are quite disputable, have been renounced everywhere in France. In the more recent locomotives these cranks are set at 180 degrees on each side of the engine and the balancing method generally adopted is a vertical balance, pure and simple.

In the same proportion as the locomotives constructed will become more powerful and heavier, this rational solution will become more necessary. And, indeed, to indicate the measure of resistance of a given roadbed and the limit of fatigue to which it is subject, we have always contented ourselves to give the maximum static load per axle without considering the periodic stresses to which the rail is subjected, due to the centrifugal force of the excess (or horizontal component) counterbalanced weights, and which practically are added to the static load. It is evident that a given road, for example, on which a static maximum load per axle of 16 tons is authorized, but which actually is able to sustain loads that may vary at certain intervals from 13 tons to 19 tons (without even considering the influence of the angularity of the main rods and the play in the springs) will be fully apt to support a load more or less constant of 18 tons and above. The use of a propelling mechanism that allows, at the highest speeds, of a vertical equilibrium pure and simple, presents that incontestable and important advantage that it permits the increase of power and consequently the weight of the locomotive without the necessary increase in the number of axles; to increase even its adhesive weight without increasing the number of coupled axles, and therefore, in many instances, to increase the traffic capacity of a given line without increasing necessarily the main elements of the permanent road.

The above considerations have led the Paris-Orleans Railways Company to increase the static load on rail under each driving axle to 41,800 lbs. in its new express locomotives of the "Atlantic" type that are now under construction, and which, of course, will have but the vertical equilibrium.

(To be continued.)

One result of the prolonged strike of the anthracite miners may be a material lessening of the Canadian demand for anthracite coal in the future. The regular shipments of anthracite this summer from Pennsylvania to the Dominion were entirely withheld, owing to the strike, but the shortage has served as a great impetus to the manufacture of peat briquettes for fuel. Several manufacturers have machines for pressing and briquetting the peat, which removes 50 per cent. of the natural moisture, after which they are dried for use. A plant near Toronto, three miles from a railroad, sells its product at the works for $3.25 a ton, and at Toronto for $4.25, and is running night and day to fill orders. Canada's peat bogs are almost inexhaustible. This is something worth looking up in this country.

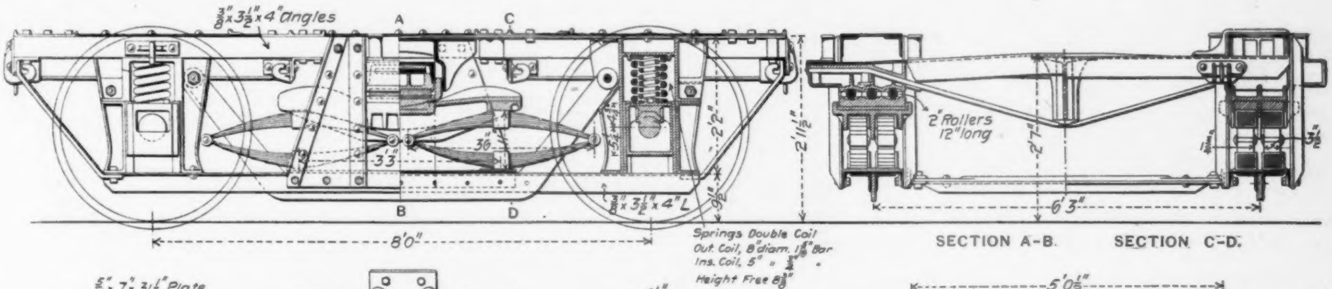
The 16-in. rifle recently completed at Watervliet Arsenal is being transported by water to the Sandy Hook proving grounds. It weighs 130 tons and the cost of moving will be $5,400.

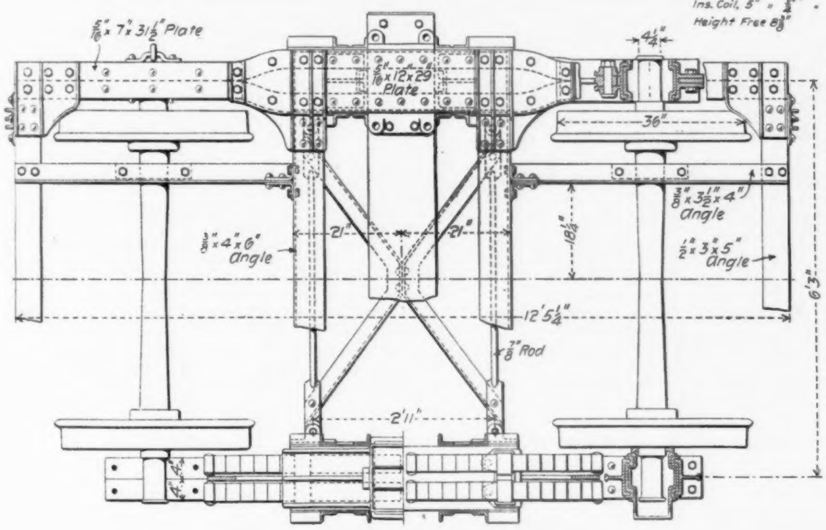
Draftsmen desiring positions should read the advertisement of the Municipal Civil Service Commission of the city of New York on page XXV. of this issue.

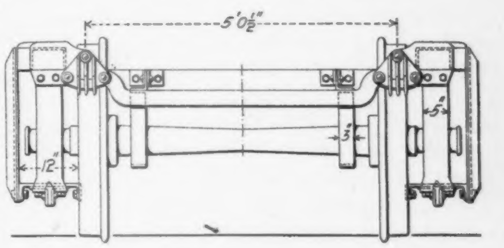
THE BARBER STEEL PASSENGER TRUCK.

Standard Car Truck Company.

This truck has been developed by Mr. J. C. Barber, of the Standard Car Truck Company, and it is now undergoing trial under a passenger car with promise of satisfactory results. It is an interesting design and does not follow wooden construction in any particular. Every part is of metal and it represents an effort not merely to substitute metal for wood, but to actually improve the riding qualities and durability of present practice. The truck shown by the accompanying drawing employs 4½ x 8 in. journals and standard M. C. B. boxes. The boxes are carried in columns protected from wear by shoes, and the outer columns are hinged so that wheels may be taken out, without raising the car, after the brace at the end of the frame is removed. The construction of the truck is such as to transmit all of the loads in a vertical direction by centralizing all the stresses in a vertical plane and transmitting them to the center of the journals. The load from the bolster is transmitted through a casting to a shoe upon rollers resting upon a steel seat. This seat rests upon the center of a strongly ribbed equalizer, the ends of which rest upon the centers of two pairs of elliptic springs. These springs rest upon a channel, which in turn is carried by a truss hung to the inner journal box columns by means of 1½-in. steel pins. This truss passes between the lower flanges of two angles which are secured to the under face of the channel, forming the seat for the elliptic springs. A glance at the sectional view shows the manner of transmitting the stresses to the center of the journals. Over the journal boxes are double-coil springs, the outer spring being 8 ins. in diameter and of 1 5-16-in. bar, while the inner coil is 5 ins. in diameter and of ¾-in. bar. The free height is 8⅜ in. The side frames of the truck are of 4 x 3½ x ⅜ in. angles. They are spread at the center and riveted to a cover plate 5-16 x 12 ins. x 29 ins. long. The bottom tie-bar is a ⅜ x 3½ x 4 in. angle. The transoms are ⅜ x 4 x 6 in. angles, with crosstie bracing for the said frames and lattice bracing of angles. The brakes may be hung either inside or outside of the wheels. The side frames have additional bracing in the form of angles and plates, on both sides of the ends of the bolsters. The side bearings are ingeniously arranged to straddle the side frames, and transmit the load which may come upon them to the truck bolster, where it will be received centrally upon the journals. Examination of the engraving will bring out additional interesting features of this construction, among which the removable shoes for the journal-box columns should be noted. The care with which this truck has been developed, and the experience of the designer, warrant the expectation that it will be entirely successful. A truck which will carry a car as smoothly as the present heavy passenger trucks and at the same time weigh very much less than they do seems to be greatly needed. The developments of experience with Mr. Barber's design will be watched with the greatest interest. The offices of the Standard Car Truck Company are in the Old Colony Building, Chicago.







Steel Passenger Truck of New Design.
Standard Car Truck Co.

A NEW AUTOMATIC CHUCKING MACHINE.

The accompanying illustration is a view of a new design of automatic chucking machine, involving several interesting new features, which has recently been brought out by the Potter & Johnston Machine Company, Pawtucket, R. I. It is available for the automatic machining of a great variety of pieces of various shapes ranging in size up to 10 ins. diameter and 6 ins. in length, in cast iron, steel or brass, and in shops where large quantities of work of this nature are required, including bushings, collars, gear blanks, valve-motion pins and the like, it can be made a most profitable producer. It is adapted to a large class of work which most turret lathes cannot handle.

The machine shown in the engraving has a belt-driven, speed-changing head and is fitted with an automatic lever chuck. The turret is five-sided, with 2½-in. holes in each face, and the turret slide is operated by the large cam drum shown below the right end of the bed, the power for which drum is taken from the spindle and delivered through gearing to a large gear located near the periphery of the drum. This form of drive provides a direct application of power to the drum and

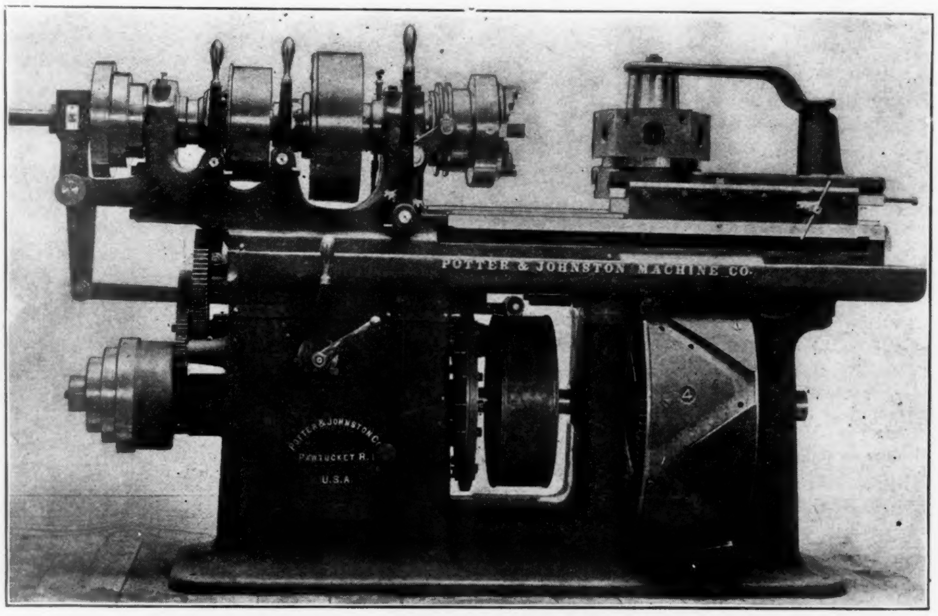
tends to prevent strains on the bearings. The standard set of cams furnished on the drum provides the necessary advancing and withdrawal motions for the machining of all ordinary pieces up to 6 ins. in length and requires no adjustment within that range, and they are so adjusted as to cause the turret to withdraw, revolve and advance at a speed of forty times that of the feeding speed.

One of the most valuable features of this machine is the automatic lever chuck. This chuck is arranged for the opening and closing of its jaws while in motion by means of the vertical lever at its rear, and by its use pieces which can be handled with one hand may be chucked or removed without stopping the machine. In this way the machine may be kept running constantly with very little attention from the operator; one man could run from four to eight such machines at the same time, according to the nature of the work being done, or a single one of these machines could very easily be run in conjunction with a lathe or other machine tool. A heavy scroll chuck is also furnished with the machine for gripping extra heavy or eccentrically shaped pieces. The different speeds for the particular type of machine here shown are obtained through the jaw clutches on the spindle, which clutches are operated automatically.

There is also furnished with the machine a cross-slide, which may be arranged to operate automatically at any time with the turret, by means of the cam drum beneath the middle of the bed, and also an automatic back-facing attachment, which is an invaluable attachment for some classes of work. The cross-slide tool blocks have a travel of 4½ ins. in either direction and have screw adjustments on the slide. The back-facing attachment enables the hubs of gears, pulleys, etc., to be finished on both ends, and other similar work to be done, at one setting, which would otherwise require two settings in the machine. A pair of universal turning and facing tools which is also furnished is of additional advantage to the equipment, and will take care of all the ordinary facing work within the machine's range, up to 10 ins. in diameter.

These machines are made with three styles of heads, viz.: With geared automatic speed-changing heads, with belt-driven automatic speed-changing head, and with plain heads. With the geared head the spindle is driven through either one of two trains of gears, each train having four changes of speed, making eight changes in all; with the belt-driven head four changes of speed are available, and with the plain head a four-step cone pulley for belt drive is used. This new machine is characterized throughout by its liberal dimensions and strength of construction, as well as by the ample bearing surfaces and the plentiful supply of power which are so necessary for heavy cuts in rapid machining.

The rapidity with which pieces may be chucked in this machine, as well as the reduction to one-half of the time required for certain operations with the back-facing attachment are very strong arguments for the use of this machine where pieces within its range are required to be machined in large numbers; if it is possible to run it in conjunction with an engine lathe or turret lathe the greatly increased product may be obtained without material increase of the cost of labor entailed.



The New Potter & Johnston Automatic Chucking Machine.

CORRESPONDENCE.

THE SHOP AS A SCHOOL.

(NOTE.—We are in receipt upon going to press of several additional letters relating to this subject which will appear in the following issue.—ED.)

To the Editor:

In the October number of your paper I was pleased to see what I consider a very timely editorial upon the training of young technical graduates for positions as foremen, master mechanics, etc. The technically educated man has been having his innings for the past few years and, rightly or wrongly, has been considered better qualified to hold the better railroad positions than the man who has grown up through the shops without a diploma. But now a change of opinion seems to be steadily gaining ground, and it is time for us to ask the reason, for, everything else being equal, the man with the higher education ought to be the better man.

From my experience in the training of young men, I believe the editorial referred to tells the whole story. Too many young men get their shop experience after the fashion of No. 1. Not realizing that their education has just begun when they leave college, they go into a shop with the idea that they have but little more to learn, and to a superficial education they add a superficial shop experience. Such a man will talk most fluently about the pitch of gears and the figuring of the counter weight of a driving wheel, but what will he know about washing out boilers, adjusting the front end of an engine to make it steam, or the intelligent instruction of an engineer or fireman regarding the proper handling of an engine? He may be able to worry through it all after a fashion, but it will be but poor fashion at best. There are a thousand and one obstacles to be met and overcome in the shops, the roundhouses and "on the road" that can be learned in but one way—by actual experience, as did your example, young man No. 2; for no book contains the information; and when it depends upon a man with the limited training of your example—No. 1—to say what shall be done, he has to do one of two things—depend upon some one who has had the experience, or let the wheels stand still while he gains the knowledge for himself.

Such a man usually has a hobby for reports, and will have his office full of clerks comparing percentages that are worthless as regards utility, and making out statements that are never read. This is because his college training predominates and everything must be in black and white to be understood. While such a superintendent of motive power will be examining his reports, one with the training of No. 2 will be watching his shops and roundhouses, looking for opportunities to get more engines into service, and to get more and better service out of them when they are there. He won't be dependent upon tabulated statements for his knowledge of the condition of his power at the beginning of a hard winter's work; he will know from his own personal observation; for from

his own experience when growing up in the business, and from his own knowledge of men he will have learned that it takes more than figures and a voluminous correspondence to run his department economically and well.

While in conversation with the manager of a large road a short time ago this question was brought up: He had a superintendent of motive power who was a great student and office man. There were reports to cover everything that took place on the road, and everybody had to make them out, from the man who hoed the ash pan to the master mechanic; and when the manager asked for the reason of a roundhouse delay or an engine "laying down" on the road he got a most elaborate report, a compilation of everybody's statement, but one that meant little, and was always too late to be of any use. That manager wanted results, not reports, and is now looking for a practical man.

What our railroads need at the head of the mechanical departments are men who not only know how to make and repair locomotives, but who can keep them turning at the roundhouses; see that they are properly cared for and gotten over the road; men who can go to either shops or roundhouses, fire cleaning track or coal dock, and talk intelligently with all classes of workmen, instruct them how to do their work and help them out of their little troubles; who can turn the tabulating work over to the comptroller, where it belongs, and devote their time to preventing the detentions and break-downs so that lengthy reports will not be necessary; men of executive ability and good horse sense. Such a man your No. 2 example should make; a man that any school and road would be proud of; a man who is sadly in the minority to-day.

SUPERINTENDENT.

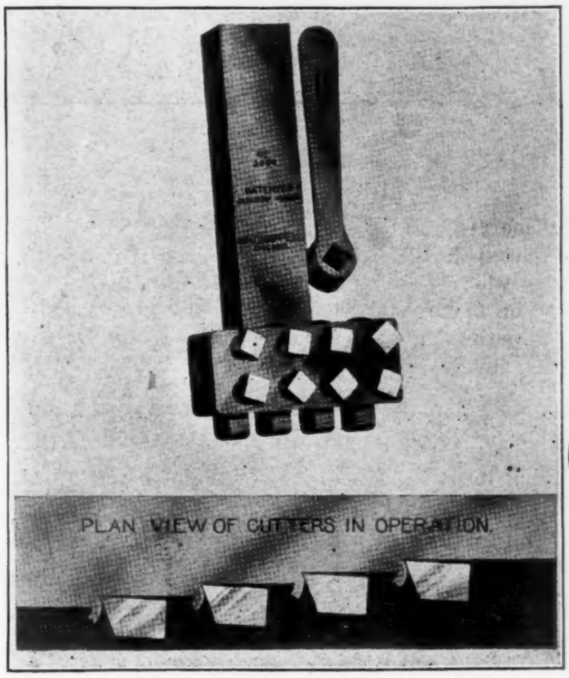
guaranteed to take a roughing cut over 14 sq. ft. of surface per hour and to stand a cut on cast iron or brass ¼ in. deep with ¼-in. feed. This tool has proved in actual service to save twice the amount paid per hour to the machinist using it as compared with a single-pointed tool. If 1-16-in. feed be used, the rear on fourth cutter will act alone. With ⅛-in. feed cutters three and four will cut; with 3-16-in. feed, the last three will cut, and with ¼-in. feed all four cutters will come into use.

A large number of the best known machinery firms in the country are using this tool, and it should be used in every railroad shop. Further information may be obtained from the Edward Smith Company, Buhl Block, Detroit, Mich. This company informs us that the Chappel patent is being infringed and that the infringers will be prosecuted. All tools made under this patent bear the imprint of the W. H. Chappel manufacture.

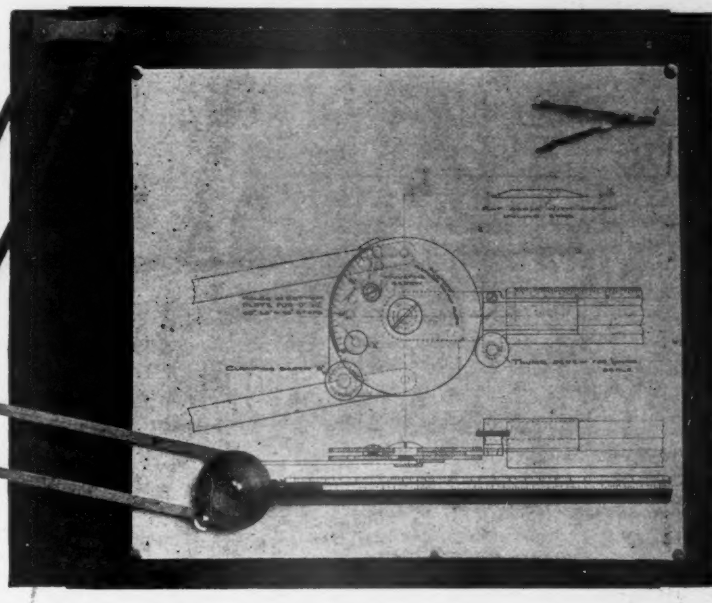
A RAPID SKETCHING DEVICE.

Since prehistoric times there has been almost no improvement in the instruments used by mechanical draughtsmen. Herewith is illustrated a real improvement which appears to be admirably adapted to aid the draughtsman and assist in the mechanical part of his labors.

This device is exceedingly ingenious and very convenient, making it possible to produce a sketch or small drawing as accurately as may be desired, using simply a triangular scale,



Chappel's Gang Tool.



The Rapid Sketching Device Applied to a Drawing Board.

CHAPPEL'S OBLIQUE GANG TOOL.

This tool is used in shapers and planers, and gives in each stroke of the machine a series of independent and simultaneously successive cuts of the full depth required, the result being that a wide surface may be planed at each stroke of the machine. It is, in fact, much wider than would be possible with a single cutter with equivalent cutting edge. In the engraving the arrangement of the tool is clearly indicated. Each cutter-bar has an individual orifice and individual set-screws to hold it in position. The series of cutters has an oblique arrangement with relation to the line of motion, each cut being slightly in advance of the next succeeding one, each stroke being equal to four of a single-pointed tool.

It is intended for roughing cuts on cast iron and brass, and will not work satisfactorily on wrought iron or steel. It is

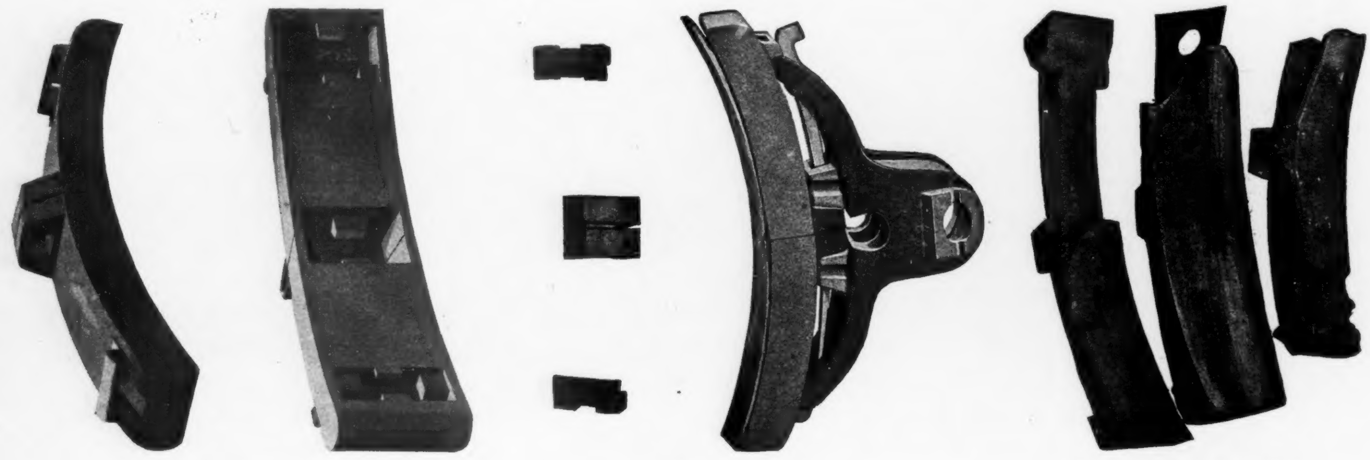
with which, by aid of the device, horizontal or vertical lines may always be drawn without attention on the part of the operator. This scale may be moved about as if nothing were attached to it. The device is intended as an aid to managers, superintendents, chief draughtsmen, and all who have occasion to make small drawings or sketches quickly.

The device consists of a scale attached to a protractor, which is supported from an anchor-plate from the upper left-hand corner of the board by means of the linkage shown in the engraving. The scale has a free motion of 90 deg. between two stops. One stop gives the horizontal line and the other stop the vertical. The two stops are fastened to a protractor and may be turned to any angle, permitting the scale to come against a stop at the desired angle, and also to one at right angles to it. The lower part of the protractor always lies in the same direction, no matter where it is moved about the board, and hence, when the protractor is once set at any

desired angle, the scale will give parallel lines anywhere on the drawing. This is accomplished by the two parallelograms, which act like a parallel ruler. The protractor may be clamped at any angle by the thumb-screw, and a spring stop is provided for the 0, 30, 45, 60 and 90-deg. points, and is operated by merely raising it and allowing it to drop into the hole for the desired angle. The scale is used exactly the same as if it had no attachment, and either a flat or triangular scale may be applied. The scales are "chucked," and may be turned to use any face. The triangular scale is preferred because of the variety of the graduations, while the flat scale offers the advantage of giving a better ruling edge. Scales of any graduation will be furnished, and those with white celluloid edges are specially recommended. The vital point in this construction is in the joints. From personal investigation the writer can say that these joints are beautifully made. They are hardened and ground, and, with such light service, should last a lifetime. The stop pins are made conical to compensate for wear. This is, as the name indicates, a device for rapid work, and we should say that not only every chief draughtsman and engineer but every individual draughtsman should supply himself with one of them. The manufacturers are the Universal Drafting Machine Company, Blackstone Building, Cleveland, Ohio. This company also make a draughting machine which was exhibited at the Saratoga convention last June and has been adopted in a number of well-appointed draughting-rooms. The writer believes this to be an excellent device, and it is time the draughtsman received some consideration in the matter of equipment for his arduous work. There has been no satisfactory improvement in draughting appliances which has come to our notice which deserves to be compared with this in importance. As to accuracy of operation, it is sufficient to say that we are informed of a recent test of a 36-in. scale on one of the Universal draughting machines in which the inaccuracy due to the joint was 0.0002 of an inch.

THE INTERLOCKING BRAKE SHOE.

The special feature of this brake shoe is its construction in two parts, permitting its attachment to the M. C. B. brake head and provision for the attachment to its base of shoes which have previously been worn down to their limit. By fitting the brake head at four points instead of three, the construction is safer and permits of self adjustment against the wheel to overcome the effect of an improperly hung brake beam. These shoes seem to wear very evenly, and, unlike ordinary shoes, which wear more rapidly at one end when the beam is badly hung. In the wearing face of the shoe, sockets are made whereby the lugs on a worn shoe may be secured and the old shoe worn entirely through, leaving only the lugs themselves as a loss. These weigh but a few ounces. The photographs illustrate the construction. One road having these shoes in use for three years has had no brake-shoe scrap during that time except from the makes of shoes on foreign cars. These shoes are made in two parts, each with lugs at the center and ends. These take the key in the usual way. When the first shoe is about two-thirds worn out it is removed from the head and placed upon the face of a new shoe, which is then keyed in position and the wear continued until the old shoe is gone and the new one two-thirds worn out. The back of the old shoe fits the face of the new one. Plain-faced shoes are provided for the initial application and for use on foreign cars equipped with shoes of other types. In contrast with this shoe, the usual form is generally scrapped at from one-half to one-third its weight. Instead of having a clearance of one-eighth inch between the lug of the shoe and the brake head at one end, this shoe fits the head at both ends and is not subjected to the heavy transverse strain which breaks many shoes, especially when they are worn thin. In this case the strain is placed on the brake head, where it properly belongs. The claim is made that in spite of the fact that this shoe is in two parts, it will involve the handling of a smaller number of pieces than with the ordinary shoe. On one road where it has been used exclusively for three years a saving of one-half is reported. Any desired material will be used. They may be made with chilled inserts or without, and of special mixtures or of gray iron. Further information may be obtained from the Manufacturers' Railway Supply Company, No. 203 Fisher Building, Chicago.



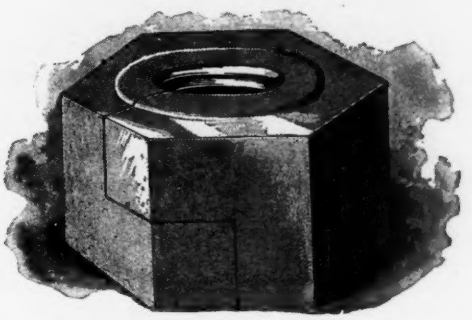
New. Worn. Worn Steel-Back Shoe.

The Interlocking Brake Shoe.

ELASTIC SELF-LOCKING STEEL NUT.

This elastic nut is made from a blank cut from a flat bar of steel. The ends are notched so that when the blank is rolled into the form of a ring and pressed in a hexagon die, it forms a perfect nut with a split on one side which opens slightly as the nut is turned on with a wrench. This split is zig-zag in form and it does not interfere with any of the functions of the nut. The nut is tapped slightly smaller than the bolt so that when put on with a wrench it is distended slightly and the split side opens about one one-hundred and twenty-eighth of an inch. This develops a constant grip on the bolt, which holds it from working loose. When made in this way, the grain of the nut is at right angles to that of the bolt, and it is always stronger than the bolt on which it is placed. The elastic opening permits the nut to be applied and removed repeatedly over rusted or battered threads, which would prevent the use of ordinary nuts. This nut is made in sizes from ⅝ to

1¼ ins. They are tapped to fit the regular U. S. Standard bolt of corresponding sizes. The elastic nut has been thoroughly tested for several years and has been found satisfactory on cars, locomotives, machinery, rail splices and for other purposes. When used in any of these services, but one nut is employed, and in car trucks a great saving is thereby effected.



Elastic Self-Locking Steel Nut

A representative of this journal has seen copies of letters showing satisfactory service where nut-locks or other types have failed. Further information may be obtained from the National Elastic Nut Company, Russell avenue and Superior street, Milwaukee, Wisconsin.

The output of the Pressed Steel Car Company in October surpassed all former records. In that month 3,000 cars were built, averaging 111 cars per day for 27 working days. This company has built 22,402 cars this year, requiring 350,000 tons of steel, not including material for numerous frames, trucks and bolsters.

BOOKS AND PAMPHLETS.

Master Car Builders' Association. Proceedings of the Convention of June, 1902. Edited by Mr. J. W. Taylor, secretary, No. 667 Rookery Building, Chicago, Ill.

This volume is of particular interest this year on account of the great importance of the subjects reported upon and the discussions regarding them, which are recorded in full. One of the most important subjects handled was the report by the committee on outside dimensions of box cars, and also important reports were made on the tests of side bearings and center plates, and on the tests of various draft gears. The Proceedings this year contains 560 pages and 54 folded plates regarding standards and recommended practices of the association. The book is well illustrated, and is bound in the usual style of binding. Credit is reflected upon the secretary for its early issue.

Poor's Manual of the Railroads of the United States. Thirty-fifth Annual Volume, 1902. Octavo, 1,640 pages, with tables, maps, and indexes. New York: H. V. & H. W. Poor, 68 William street. London: Effingham Wilson.

The fact that the stupendous work of compiling the statistics of the railroads of the United States for a year can be completed before the end of the following year comes as an annual surprise. This volume contains complete reports representing 191,946 out of a total of 198,787 miles. It shows an increase of 4,453 miles during the year, and gives traffic statistics of 194,512 miles of road. The great value of the statistics lies in their completeness and in the special figures for each separate road, and the fact of their prompt appearance. These reports are the most valuable of their kind in the world, and while the Government statistics, prepared by the Interstate Commerce Commission have a value of their own, they give little information with reference to the individual companies. Poor's Manual, on the other hand, presents the organization, results of operation, history and financial position of every individual road in the country. Not only steam but street roads are given, the latter occupying a continually increasing share of space in the annual volumes. Canadian railroads are included; also miscellaneous corporations. The work includes tables of dividends paid by railroad and other corporations, a ready-reference bond list of leading steam roads, statements of annual meetings and transfer agencies, a list of railroads merged into other lines, statements of State and municipal indebtedness, a directory of railroad officials, and indexes of the contents. The manual not only holds its own but increases in value every year because of its continual extension. It is really a manual of the most important industry of the world, and has long been indispensable to those having financial interests in railroads.

"Oil-Burning Locomotives."—This is the subject of the Record of Recent Construction No. 37, published by the Baldwin Locomotive Works. Beginning with the discovery of oil, the use of liquid fuel in steam-raising is briefly traced and its earliest application to locomotives is considered. Following this is a liberal abstract from Dr. C. B. Dudley's published statements in this connection, in which a comparison of oil and coal as to relative cost is prominent. The advantages of oil over coal are considered, and the concluding pages describe, by aid of engravings, the successful practice of the Baldwin Locomotive Works in their experience in equipping 250 locomotives for oil-burning. This pamphlet is an important contribution on this subject, and should be filed for reference in the library of every motive-power officer.

Pintsch System of Car and Buoy Lighting.—The Safety Car Heating and Lighting Company has issued a tasteful and attractive pamphlet of 40 pages illustrating "an established and successful system" of lighting. It contains excellent half-tones of 59 plants for the manufacture of Pintsch gas, distributed from Maine to California and Mexico. The text presents the facts concerning this system and its development, and the impression received is that the Pintsch system is a product of study, experiment and practical experience of many years and that it may be regarded with confidence as a satisfactory system. No one can examine this fine pamphlet without being impressed with the solidity of the system and its large extent. The use of Pintsch gas in buoys as an aid to difficult navigation also receives attention.

The Jeffrey Manufacturing Company, Columbus, Ohio, have issued a new catalogue of elevating, conveying and power-transmission machinery. This is catalogue No. 72, a pamphlet of 372 pages, illustrating, from photographs of machinery in actual use, the product of this company, showing how it may be adapted to almost every known industry. Those interested in coal or ash conveyors, wire-rope transmission, electric locomotives and sprocket-chain devices of all kinds, should procure a copy of this catalogue.

Pratt & Whitney, Hartford, Conn., have recently issued a new catalogue descriptive of their new model of profiling machines. They have recently brought out this new model, involving a great many very valuable improvements over their previous types, the main feature of the change being a new principle of drive for the spindle. The drive is now through a pair of 45-degree spiral gears located within the head, but not in any way interfering with the traversing motion of the spindle. The result of this change is a greatly simplified and more efficient machine, its size being reduced nearly one-half for the same capacity. Other valuable improvements are also incorporated, notable among which are split or divided gears for the head traverse and table cross-feed motions, whereby all lost motion may be absolutely eliminated.

The Chicago Pneumatic Tool Company have recently issued a beautifully illustrated 72-page catalogue of the air-compressors manufactured at their Franklin (Pa.) plant. It contains new illustrations of all the latest types of compressors and a very complete illustrated description of the chief features of their design; also, all necessary data pertaining to standard styles of compressors, an article on the uses of compressed air, and much valuable information relative to the proper installation of compressed-air equipment and tables not usually printed in similar publications, are given. Although designed primarily for the operation of pneumatic tools in shop and field riveting, drilling, chipping, hoisting, etc., and possessing features particularly desirable for such duty, these compressors are also suitable for all of the customary employments of compressed-air power.

This company has also issued a pneumatic hoist catalogue, describing and illustrating their new line of the pneumatic hoists formerly manufactured by the Chisholm & Moore Manufacturing Company. Either one of these catalogues will be mailed free to anyone interested.

AD-EL-ITE PAINT PRODUCTS.

Something which will remove paint and varnish quickly and satisfactorily has long been sought for, and from what is said of a material called "Ad-el-ite," manufactured by the Adams & Elting Company, of Chicago, it seems that the right thing has been found. This is in a liquid and semi-paste form. It is said to remove varnish and paint very quickly, and there are apparently no disadvantages connected with its use. For example, it contains no water, alkali or acid; has no objectionable odor; does not injure the hands, and does not soften glue nor raise the grain of veneers or woods. It is said to be free from all injurious effects, and is in demand for refinishing cars, yachts, carriages, furniture, and cabinetwork of all kinds. One gallon will entirely remove from 200 to 300 sq. ft. of surface.

The same manufacturers produce "Ad-el-ite" enamels and wood finishers' supplies. They also manufacture a car cleaner which contains no potash in any form, and is both a varnish-preserver and cleaner.

Attention has been called repeatedly in these columns to the importance of using better material for painting the front ends or smokeboxes of locomotives. This concern manufactures "Ad-el-ite Black" for locomotive front ends, and they are prepared to send an expert to show its merits and economy by making a practical demonstration. The address of the Adams & Elting Company is 155 Washington Boulevard, Chicago, Ill. This company has had a long and satisfactory experience in the manufacture of wood finishers' supplies and paint specialties.

Illustrated Sectional Catalogue, No. 141, of the American Blower Company, Detroit, Mich., has been received, descriptive of blowers. Steel pressure blowers, volume blowers and fan blowers are illustrated and described together with necessary auxiliary apparatus. Also, this company has issued a brochure illustrating the "A. B. C. Co. at Home," in which all departments of their large factory are interestingly set forth.

The scrap pile is not attractive in any sense, but it contains lessons which are most important. Sooner or later it includes the best as well as the worst of everything used on a railroad, and an occasional hour spent in examining the truths which it tells as nothing else can tell, is time well employed. This idea is not original at all, but it is brought to mind by a leaflet just received from the Boston Belting Company, bearing a photograph of a pile of discarded air-brake hose, suggesting an examination of the scrap pile to show the brand of hose that lasts the longest.

The Franklin Machine Works, Inc., Philadelphia, Pa., have issued a catalogue illustrating and describing the machine tools of their manufacture. Their improved types of horizontal floor boring, milling and drilling machines, which were illustrated and described on page 325 of the October issue of this magazine, and their plain milling machines, are well illustrated and set forth. This company also makes a specialty of cold saw cutting-off machines, the catalogue illustrating three sizes of bar saws, universal cold saws, steel foundry saws, and crank-shaft saws as well as improved automatic sharpening machines for these cold saws.

MANUFACTURING NOTES.

An order was placed November 7 by the American Car and Foundry Company for 20,000 1⅜-in. Bartley nut locks, manufactured by the American Bolt and Nut Fastener Company, 306 Frick Building, Pittsburgh, Pa.

The Kindl Car Truck Company have opened an office at 425 Anstell Building, Atlanta, Ga., where their interests will be looked after by Mr. P. H. Wilhelm as Southern agent.

The Holland Company has recently been incorporated in Illinois with offices at 77 Jackson Boulevard. The officers are Mr. Alex Holland, president; Mr. J. C. Martin, Jr., vice-president, and E. B. Pickhardt, secretary and treasurer. These gentlemen have been associated with well known railroad supply concerns. They are now manufacturing the Sharp journal box, the Martin flexible steam coupling and other railroad equipment devices.

The smokestacks of the Fall River Line steamer Priscilla, of the New York, New Haven & Hartford Railroad, and the stack of the Pennsylvania Railroad grain elevator, New York harbor, are protected by Dixon's silicon-graphite paint. This and other information is noted in a leaflet issued by the Joseph Dixon Crucible Company, Jersey City, N. J., including a statement that this paint has been continuously used for nearly 40 years by many of the largest steamship, smelting and manufacturing companies in different parts of the world.

Notwithstanding the fact that the Otto Gas Engine Works, Philadelphia, added 12,000 sq. ft. of floor space to their plant less than two years ago, their increasing business is again crowding them, and the last available bit of ground in the block covered by the works is having a building 45 ft. by 100 ft. erected upon it. The demand for large units makes necessary these increased facilities, and the new building will be equipped with the largest and latest types of machine tools. The tools are ordered, and the new shop should be running inside of six weeks.

The Pittsburgh Filter Manufacturing Company, Empire Building, Pittsburgh, Pa., state that they have had an unusually busy year installing waterworks filters and water-softening plants. In a recent letter they mention having constructed the largest water-softening plant in the world, having a capacity of 2,500,000 gallons, for the Tennessee Coal, Iron and Railway Company, Birmingham, Ala. They have also furnished six plants ranging from 500 to 7,500 horse-power in capacity and seven plants ranging from 600,000 to 2,000,000 daily capacity for various manufacturers and waterworks.

The Chicago Pneumatic Tool Company reports a very large increase in sales during the past few weeks, and all of its factories are working night and day in an endeavor to fill the orders which are pouring in. Especially is this the case in the air-compressor department at Franklin, Pa., which is being pushed to its utmost capacity. Mr. J. W. Duntley, president, is still continuing his business trip on the Continent, and his route is announced by the cables continually being received by the Chicago office containing large orders for pneumatic tools, annealing machines, rivet forges, etc. His return is not definitely announced, although he will probably leave Europe in the very near future.

The Gold Car Heating and Lighting Company is to be congratulated upon securing the services of Mr. Charles L. Gateley. Mr. Gateley has had a wide experience, and possesses a large acquaintance among railroad men, which will be particularly valuable in the work in which he is now engaged. He is a graduate of Stevens Institute of Technology, and began his railroad experience in the West in connection with the Missouri Pacific Railroad. His experience has brought him into close contact with car construction and particularly with heating and lighting problems, in which he is specially well versed. Mr. Gateley is also congratulated upon his connection with such a firm as the Gold Car Heating and Lighting Company.

H. K. Porter Company, Pittsburgh, builders of light locomotives, report very active business conditions. They have just completed two 24-in. gauge compressed air mine locomotives for a large lead company in Missouri; also a heavy compressed air locomotive for the mines of the Keystone Coal and Coke Company, of Pennsylvania, and additional air locomotives are now building for the McCormick Harvesting Machine Company, to be used at the Chicago works. Another order is being filled for the Central Coal and Iron Company, Alabama. Contracts have recently been closed for similar machines, including the equipment of the Dominion Iron and Steel Company, Sidney, Cape Breton. The shops are now engaged in building a number of steam mine locomotives for West Virginia and Pennsylvania, also a number of logging locomotives for the West and South. Lately there has been an unusual demand for this machinery for steel works and contractors, for switching locomotives, and the books show a large number of orders for export to Mexico, the West Indies, Japan and South America.